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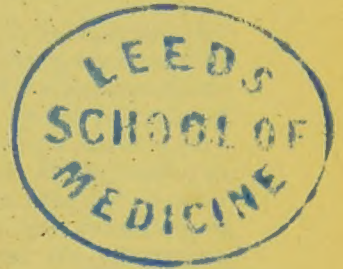
BY

VARIOUS BRITISH HOSPITAL SURGEONS

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MACROGLOSSIA—ZYGOMA

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may be healthy. The tongue hangs forward over the chin, and its surface is constantly dry and the papillæ are prominent. Small hæmorrhagic puncta are seen beneath the mucous membrane, and between the elevations are sores and fissures. The tongue can by an effort be drawn into the mouth, but, except when voluntarily retracted, it is habitually protruded. The oral passage being obstructed, breathing is performed chiefly through the nostrils, which are, therefore, dilated. The constant dribbling of saliva causes a rough, red, eczematous eruption on the skin covering the chin. If punctured, the exudation will appear more serous than bloody. This condition has first to be distinguished from that of acute glossitis, in which the history of some injury or cause, and the rapid onset of the swelling, together with the pain, the glazed appearance of the surface of the organ, which is observed to fill the cavity of the mouth but to protrude but little from it, point to the true nature of the affection. A condition for which true macroglossia has been mistaken, and for which amputation has been erroneously performed, is that which is seen in some idiotic children, particularly in those who are described as 'sporadic cretins,' in whom the mouth remains open, and the tongue lies between the gums or even is advanced beyond them; but the vacant look and absence of all expression, the small forehead and general dwarfed appearance, added to the fact that the size of the tongue does not undergo any increase, should obviate this mistake.

Treatment.—Compression has in many cases effected a cure, and should, at all events, be given a fair trial. This is best accomplished by strips of isinglass plaster placed round the organ, much in the manner of strapping a testicle. Beneath this, small strips of calico, which have been steeped in a solution of alum, tannin, or some other astringent, may be wound round the tongue; or a linen bag may be made to fit the protruded portion and be tied behind the head with tapes. When the tongue can be retained in the mouth, the chin should be supported by a bandage secured over the vertex, and the mouth thus kept constantly closed. All these means are, however, difficult of application, and the alternative of excision will in most cases have to be resorted to. This is best performed by excising a V-shaped portion, with scissors or a bistoury, from the end of the elongated member. The hæmorrhage is not severe, and the vessels are easily secured with cat-gut ligatures, when the edges of the wound

thus made can be brought together by one or more silver wires passed deeply through the substance, thus drawing the parts firmly together, while the edges are superficially united by means of fine wire or horsehair. This is more likely to obtain primary union than any other method, but the *écraseur* or galvano-cautery may be used with the same purpose. The period at which operation is to be resorted to should, if possible, be before dentition has commenced, and the sutures should be removed before suppuration in their track has occurred. The introduction of setons or the injection of astringent fluids is worse than useless. As regards medicinal remedies, there is some advantage in putting the patient on cod-liver oil and some preparation of iron. JOHN H. MORGAN.

MADURA FOOT. See FUNGUS DISEASE OF INDIA.

MALACOSTEON. See OSTEOMALACIA.

MALAR BONE, Fracture of the. See FACE, Fracture of Bones of the.

MALIGNANT PUSTULE (*Synon.* Anthrax Charbon, Woolsorters' Disease, Mycosis Intestinalis) is a specific affection caught from animals suffering from splenic fever, a disease which occurs sporadically in cattle in this country, but is endemic and very fatal in many other parts of the world. Graminivorous animals, and especially horned cattle, sheep, and horses, are liable to splenic fever, and the disease may spread to those who have to tend the beasts when alive, or to handle their hides and flesh after death. It is in the latter mode that the infection is usually conveyed in this country, where, of late years, the disease has occurred with some frequency among the tanners of foreign hides in Bermondsey, and the sorters of Van mohair in Bradford. It has also been observed in those who have eaten the flesh of infected animals, and instances are on record in which the disease has been communicated by butter or milk, or by the bites of flies. There are two forms of the disease, the external and internal.

1. The *external* form is the one which usually comes under the notice of surgeons. It is generally seen as a characteristic eschar, to which the name *malignant pustule* has been very incorrectly applied, for one of the peculiarities of the disease is an entire absence of pus-formation until the throwing off of the slough. From a few hours to several days, or even weeks, after the contagious material has come into contact with the skin, a small itching red

pimple appears upon some exposed part of the body, such as the face, neck, or arm. A vesicle soon forms upon the papule, containing serum and frequently a little blood. This is either opened by scratching or dries up. Meanwhile the papule grows and becomes an indurated red area, upon which other vesicles form around the first. As the disease progresses, the earlier vesicles sink down, and a slight central depression of a dark dingy purple colour appears, surrounded by a ring of closely set pearly vesicles, two or three deep. This indurated area may attain a diameter of more than an inch. It is usually elevated one-eighth of an inch above the healthy skin around, and the central depression is about one-twentieth of an inch below the level of the adjacent vesicles. Soon, the parts around become slightly flushed, swollen, and œdematous; and this swelling may be so great as to level them with the indurated area, which, however, can always be distinguished by its appearance and hardness. At the same time the lymphatic glands enlarge; but this may be in a great measure concealed by the brawny œdema of the subcutaneous tissues, which is often accompanied, as the disease progresses, by some livid discoloration of the part. There is a remarkable absence of pain in and around the eschar, pricking or a slight gnawing sensation being usually all that is felt.

Constitutional symptoms set in from a few hours to eight or ten days after the appearance of the papule. They bear no exact relation to the amount of local trouble. There is pallor, and in bad cases, cyanosis, with languor and a feeble pulse. Dyspnoea may be observed upon slight exertion, and occasionally there is a cough, or a sense of constriction of the chest. Vague pains and stiffness are complained of in various parts of the body, with chilliness or even rigors. There may be sleeplessness, restlessness, headache, giddiness, and more rarely delirium. In some cases the nervous symptoms are more severe. Convulsions or tetanic spasms occur, followed by coma. In others, the intellect is clear and the voice strong to the last. There is usually loss of appetite, and sometimes vomiting or diarrhoea, with abdominal pain. The temperature is often high, but it is subject to rapid variations. The patient may sink into a typhoid condition and die exhausted, but more often death is the result of sudden syncope, or, where some part of the neck has been the seat of local mischief, œdema glottidis supervenes

and proves fatal by asphyxia. Death usually occurs within five or six days from the beginning of constitutional infection. In favourable cases the general health is not seriously affected. The vesicles may dry up in a few days, and form a black slough, which is separated and cast off by ordinary inflammatory processes.

In some patients, the ring of vesicles may be absent from the eschar, which then consists of a well-defined firm elevation, of a pellucid red colour, with a dingy purple central depression. Except that it is much harder, this form may bear rather a close resemblance to a nævus. A rare variety of the external form is *malignant œdema*, which is said to occur sometimes as a primary disease in those who have eaten the flesh of infected animals, or have inhaled the poisonous matter through their lungs. Beginning as a soft, doughy, pale swelling of moderate extent, it spreads rapidly at its circumference. Vesicles are not always present, and when they appear, are scattered irregularly over the surface. Constitutional symptoms rapidly follow the development of the swelling.

2. The *internal* form presents symptoms which are in most respects identical with those which indicate constitutional infection in the other variety. In this country the *woolsorters' disease* has usually assumed this form. According as the contagion has been received by the lungs or alimentary canal, the disease may take the form of a broncho-pneumonia or gastro-enteritis. In either case it is generally accompanied by great prostration and mental depression; frequently, also, there is lividity of the lips and nails, or more general cyanosis without any physical signs to account for its presence. The incubation may last from two to ten days or even several weeks, and the majority of the cases end fatally in a few days. Occasionally the internal variety is followed by the development of the malignant pustule or œdema upon the skin.

Pathology.—The essential feature of this disease is the presence of a micro-organism, the *bacillus anthracis*, in the tissues. Under the microscope this is easily seen as a well-defined cylindrical body, of a much larger size than the bacteria which are usually found in decomposing matter. The diameter is generally about $\frac{1}{18000}$ th of an inch, while the length varies from $\frac{1}{2000}$ th to $\frac{1}{1400}$ th of an inch, and here and there much longer filaments may be observed. Most of them are straight, but a few are curved or bent at an acute angle. Upon careful examina-

tion some are seen to contain transverse markings, and they have a tendency to break up into segments at these points. Ovoid spores may sometimes be seen in their interior, and occasionally collections of these spores are found in the adjacent tissues. In the external form, the central parts of the eschar are dried up to a leathery substance, while the surrounding skin and the subjacent tissues are infiltrated with fibrinous exudation. Small patches of ecchymosis occur in the deeper layers of the corium, and sometimes in the muscles beneath, but nowhere is there any appearance of pus. The vessels are not affected. The adjacent glands are swollen, and sometimes ecchymosed. The characteristic bacilli, with their spores, abound in the fibrinous exudations beneath the Malpighian layer of the eschar. They are also found in the superficial strata of the corium, and outside the sheaths of the hair-follicles. Although they are probably conveyed by the blood to the other parts of the body, it is rare to find them in the vessels near the eschar or in the blood of the patient during life.

In the bodies of those who have died from either the *internal* or *external* form of the disease, the surface is generally cyanosed and there are signs of rapid decomposition, the blood is thick and dark and does not coagulate. Small hæmorrhages are found in the viscera, and under the mucous and serous membranes. Effusions of blood and serum are met with in the pleural, peritoneal, and other serous sacs. The lungs are congested or inflamed, with nodules of ecchymosis upon the surface or in their substance. In some cases there is œdema of the upper part of the larynx. Blackish raised patches, formed by extravasated and decomposing blood and somewhat resembling the external eschar, may be found studded over the internal surface of the stomach and intestines. They are surrounded by gelatinous infiltrations of the mucous membrane, and in many cases the process of separation by sloughing is already far advanced. The liver and spleen are often large, congested, and softened, and the mesenteric glands may be swollen and ecchymosed. Hæmorrhages may be found in the cerebral and spinal meninges. Upon microscopic examination, the bacilli are found abundantly in the patches of ecchymosis and the surrounding infiltrations. In cases which recover from the constitutional infection, the writer has seen the bacilli in the sputa, sweat, fæces, and urine.

Diagnosis.—In most cases, the characteristic eschar of the external form is easily recognised. The raised indurated area, with its central blackish depression surrounded by a ring of closely-packed vesicles, can hardly be mistaken for any other affection. Further confirmation may be obtained from the painlessness of the swelling, the occupation of the patient, and the finding of bacilli in the serum obtained by scraping the vesicles. The disease is sometimes confounded with a boil or carbuncle, and especially with the acute and very dangerous form of the latter which sometimes attacks the face. Both these affections, however, are from the first painful, and they soon show evidence of suppuration. In the same way, it will usually be easy to distinguish it from an ordinary poisoned wound. When the vesicles are drying up, it may somewhat resemble a chancre of the face, but the history of the case, the rapidity of development, and the absence of tenderness would usually suffice for the recognition of malignant pustule. When the soft parts are much affected, its appearance may approach that of erysipelas or cellulitis, especially where the eschar is small, or, in the case of malignant œdema, where it is absent. Here, however, the occupation of the patient would afford a clue, and a microscopic examination of the serum would probably show the presence of bacilli. There is also a peculiar pallor and a tendency to the formation of cyanotic patches, which is not observed in ordinary cellulitis. In the internal form the diagnosis of isolated cases is very difficult, and they may easily be mistaken for ordinary pneumonia when the lungs are primarily affected, and for enteritis or typhoid fever when the intestines are chiefly attacked. But when several cases have occurred, or where the occupation of the sufferers makes it probable that they have been exposed to the contagion, the peculiar and sudden prostration, together with the tendency to a cyanotic condition, for which the physical signs afford no satisfactory explanation, will be enough to suggest the true nature of the disease, and further evidence may be obtained by the microscopical examination of the blood and excretions.

Treatment.—In the *external* form, it is of the utmost importance to destroy or remove the whole of the indurated area which forms the primary eschar. This is most effectually done by the knife, and care should be taken to dissect away the whole thickness of the affected skin, together with about one-eighth of an inch of the, apparently healthy, adjacent tissue.

When the hæmorrhage has been checked by pressure or ligature, the exposed surface should be examined, and if it should present any appearance of discoloration or ecchymosis, some cauterising agent should be employed, such as chloride of zinc paste (i.e. one part of the chloride to three of flour), or potassa fusa, or the thermo-cautery. In Turkey, where the disease is frequent, the usual plan is to destroy the whole eschar with the actual cautery; and in France the use of potassa fusa, for this purpose, has been strongly recommended by Bourgeois. Success has also followed the subcutaneous injection of the liquefied crystals of carbolic acid. It is generally desirable to have either or chloroform administered, but where the patient objects, or where his languid and cyanotic condition indicates that an anæsthetic would be dangerous, the operation can be performed without this assistance, and it is not attended with much pain. The wound should be dressed with carbolised oil, or boracic acid ointment spread on lint.

Recovery usually follows the removal of the primary lesion, even when the swollen state of the parts around and of the adjacent glands, together with severe constitutional disturbance, proves that the disease is no longer local. Probably, the eschar acts as a nursery from which the infective material passes into the system, and after excision the patient is in a better position to throw off that which has already passed into the circulation. In some cases, in which the surrounding cedema is already excessive, or in which after excision the swelling still spreads, it may be necessary to incise freely the swollen tissue, or resort may be had to the subcutaneous injection of some antiseptic fluid, such as an aqueous solution (1 in 20) of carbolic acid. The same treatment would be required in malignant cedema. Constitutional symptoms should be treated by absolute rest in bed, with a plentiful supply of animal food, such as beef-tea, milk, and eggs. If the heart's action is weak, ammonia and alcoholic stimulants should be freely given. Large doses of quinine are beneficial. The internal administration of sulphite of sodium in 10-grain doses has been recommended, on account of the success which has attended its use in the splenic fever of animals. Where there is evidence of obstruction to respiration from cedema glottidis, laryngotomy should be performed. The subcutaneous injection of morphia may be required in those cases in which sleeplessness is a distressing symptom, and opium may be called for to check the diarrhoea produced by the gastro-intestinal lesions.

Where the lungs are affected, senega and other expectorants will be useful, and the patient may be made to inhale air charged with carbolic acid or some other antiseptic agent.

N. DAVIES-COLLEY.

MALIGNANT TUMOURS.—All malignant tumours are either Sarcomata or Carcinomata, and display their malignancy in similar ways, though to a very varying extent. For, whilst an innocent tumour may, by its weight, size, and position, become dangerous to the comfort and life of the patient, malignant tumours destroy by other means as well. Malignant tumours differ from innocent growths in the following particulars:—1. Mode of growth; 2. glandular affection; 3. dissemination; 4. interference with the general health; 5. local recurrence after removal.

1. MODE OF GROWTH.—All malignant growths tend to *infiltrate* the tissues in which they grow, and it is in their growth by infiltration that they essentially differ from the innocent tumours. They may also be said to grow at their *periphery*, innocent tumours from their *centre*; and, although this is not absolutely true, perhaps, in all cases, still it is a broad fact which generally holds good. In consequence of this infiltration and peripheral growth, malignant tumours are practically never encapsuled, although to the naked eye they may sometimes appear to be so, but actually blend with, and are inseparable from, the tissues in which they develop. They never simply push aside the structures amongst which they grow. This infiltration is more marked in the carcinomas than in the sarcomas, and the latter are, at times, apparently encapsuled; whilst, at the growing edge of the former, the remains of the surrounding structures may be seen entangled in the tumour-growth. But, in addition to its infiltrating mode of growth, a malignant tumour increases with much greater rapidity than does an innocent one. Its blood-supply is large, its cell-multiplication rapid, and within three or four months it may attain a considerable size. The skin covering such a growth is at first simply stretched over it; then, especially in the carcinomas, it becomes dimpled and puckered by the inclusion of the subjacent tissues; and finally, becoming itself infiltrated and adherent, allows of the protrusion of a fungating mass. This protruding growth is often foul-smelling, very vascular, and readily bleeding; and the patient is worn out by the combination of septic conditions with profuse discharge of

blood and pus. Large fungoid masses occur, especially in connection with rapidly growing tumours; for, where the growth is slow, it ulcerates and disintegrates on its exposed surface almost as rapidly as it is produced. This is very evident if an encephaloid cancer be compared with an epithelioma.

A malignant growth may become the seat of inflammatory changes; suppuration and the formation of a definite abscess within the tumour may occur. All the usual signs of inflammation may be present, and the abscess may point and burst, in just the same way as a similar collection of pus in an otherwise healthy tissue. This is especially common in the case of lymphatic glands the seat of new growth secondary to epithelioma.

2. GLANDULAR AFFECTION.—One of the best marked and most widely recognised evidences of malignancy is found in the affection of the neighbouring lymphatic glands. This glandular affection has nothing whatever to do with inflammatory processes, for, although the latter may be present, they in no way bear evidence to the malignancy of the growth. The glands are affected by the production in them of new growth, precisely and in all respects similar to, and identical in structure with, the original tumour; so that in the glands are reproduced, with the most perfect mimicry, all the little varieties of structure met with in the original cancer. Innocent tumours do not so affect the glands.

But although glandular affection may be said, in general terms, to be of common occurrence in the cancerous growths, the question whether the glands shall be so diseased in any given case depends upon two conditions—(a) the character, and (b) the locality of the growth.

(a) *Character*.—Speaking generally, it may be said that the carcinomata much more frequently cause glandular infection than do the sarcomata; but that, of the carcinomata, the rodent ulcers practically never infect the glands, and the adenoid carcinomata not nearly so frequently as the other groups of the same class. The epitheliomata and spheroidal-celled carcinomata most generally cause glandular affection. The sarcomata, on the other hand, do not as a rule affect the glands—i.e. when they occur in those situations in which they most generally come under the notice of the surgeon, as apart from the physician. But one variety, nevertheless—the melanotic sarcoma—does, almost invariably, cause glandular infection.

(b) *Locality*.—Carcinomas in certain localities rarely affect the glands. This is especially true of all the varieties that are found in the œsophagus, stomach, and intestines, as well as in the superior maxillary bone. Sarcomata of the testis, the tonsil, and of the mediastinum, always result in glandular affection, as do, more rarely, similar growths in other situations; whilst sarcomata of the breast, of the subcutaneous tissues, and those growing in or around the bones, almost never infect the glands.

3. DISSEMINATION.—Although malignant tumours, as a whole, are prone to cause metastatic growths, this phenomenon, like glandular affection, is influenced by—(a) the character, and (b) the situation of the tumour.

(a) *Character*.—Rodent ulcers never tend to become disseminated. Epitheliomas and adenoid carcinomas do not become disseminated nearly so frequently as do the spheroidal-celled carcinomas, and, of these latter, the scirrhus growths are less liable to dissemination than are the encephaloid tumours. Of the sarcomas, the round and mixed-celled groups are those which are the most likely to be associated with metastatic growths, and the melanotic variety is in this respect of a very malignant nature. The spindle-celled sarcomas often become disseminated, but not so frequently as the above groups. And, still speaking of the sarcomata, it may be said that the more the tumour tends to become developed into one of the higher forms of adult tissue, the less likely is dissemination, so that the fibro-sarcomata often do not become disseminated at all.

(b) *Locality*.—But, whilst laying due stress on the influence which the structure of the growth exercises upon the question of its dissemination, it must clearly be borne in mind that its locality is also of great importance. Thus, epitheliomas of the lip and vulva are much less liable to become disseminated than are those of the tongue. Carcinomatous growths of all kinds, occurring in the œsophagus and stomach, often run their entire course without metastasis, whilst precisely similar growths, in the testis or in the breast, are extremely prone to become disseminated. So also with sarcomas. Thus, round-celled sarcoma of the testis tends to become most rapidly disseminated, and is altogether of a very malignant nature; whilst a similar tumour in the parotid gland is practically never followed by metastasis. Fibro-sarcomas of the skin and subcutaneous tissues often

run their entire course without occurring in distant organs. Similar tumours in the breast follow a like course, whilst those fibro-sarcomas which occur under the periosteum of the long bones tend to become widely disseminated, and run a very malignant course.

4. AFFECTON OF THE GENERAL HEALTH. There can be no doubt that, in the growth of malignant tumours, the general health does often become very markedly affected, and that, more particularly, the patient loses weight to a very considerable extent. This wasting and loss of health were formerly supposed to indicate a cachectic condition that was typical of cancer; and although this is no longer generally accepted, it is certainly a fact, that a patient with a malignant growth often wastes to an extent which is out of all proportion to the apparent demands made by the disease upon his vital resources. As the growth increases in size and the viscera become the seat of secondary tumours, the emaciation and weakness become more marked. Special symptoms will be developed according to the particular viscus diseased.

5. LOCAL RECURRENCE. — Almost all tumours which show their malignancy in one of the ways already mentioned, are also prone to recur locally when removed; but many other growths which do not tend to become disseminated or to affect the health of the patient, do tend to recur locally and sometimes to affect the glands. Such growths as these are said to have a 'limited malignancy,' and the chief of them are the fibro-sarcomas or recurrent fibroids of the skin and subcutaneous tissues, the rodent ulcers, and, to a less extent, the epitheliomas of the skin surfaces of the body and of the lips. In the section on etiology this question of recurrence will be alluded to, and here the writers will merely say that the liability to recurrence is apparently more than can be accounted for by simply inefficient removal, though this is undoubtedly accountable for a return of disease in many instances. These recurrent growths, when sarcomata, appear to run one of two pretty definite courses—either the interval that elapses between removal and recurrence of each recurrent tumour steadily diminishes, or else it tends to increase. So that a growth may recur at intervals of six, three, and two years, then after a few months, and then in the wound before it is soundly healed. Or, on the other hand, after two, three, or more removals the tumour may never reappear. The former is unfortunately by far the more common of

the two alternatives. When the period of time that elapses between each removal tends to diminish, it will often be found that the character of the tumour varies with each removal, so that whilst the first growth may have been a fibro-sarcoma, the others gradually become more and more cellular, and the last is perhaps composed of nothing but spindle and oval cells. Yet the tumour may never become disseminated.

ETIOLOGY OF MALIGNANT TUMOURS.—It must be owned at the outset that our knowledge of the causation of sarcomata and carcinomata is very defective—in fact, that it is almost entirely hypothetical. There are, nevertheless, several well-ascertained predisposing and exciting causes, which may be shortly discussed.

(1) *Inclusion Theory*, or embryonic hypothesis of Cohnheim.—This theory may be briefly stated as follows. At the time when the various tissues are becoming differentiated in the embryo, it is supposed that more cells may be produced than are required for the proper formation of the growing tissue or organ; that, not being utilised, they may remain in the locality in which they originally grew, and may become enclosed and surrounded by the fully-developed structures in which they are placed. This small mass of germinal embryonic cells may remain quiescent throughout the life of the patient, or may be lighted up into active growth either by the application of some artificial irritation, or by the normal physiological activity of the part excited in a natural manner.

With regard to this hypothesis, it is here enough to say that it is not sufficiently supported by either physiological or histological research to allow of its general acceptance, and that our knowledge of the life of the tissues renders it extremely improbable that masses of embryonic cells could remain in an unaltered condition—i.e. retain not only the formative, but also the vital and inherent properties of embryonic cells, whilst surrounded by tissues which are undergoing daily metamorphosis.

(2) HEREDITARY INFLUENCE.—It is a fact that, in a certain proportion of cases of 'cancer,' a history of similar disease in the same family may be obtained; and, considering that a very large number of patients are absolutely ignorant of the cause of death of even their near relations, it is quite certain that the ascertained proportion would be increased if accurate histories could be always elicited. It must be clearly borne in mind, however, that even if the hereditary nature of cancer were clearly proved.

this would in no way imply that cancer is therefore a constitutional or blood disease, for just as certain local affections, such as club-foot, hare-lip, multiplicity of digits, &c., may be transmitted from parent to offspring, so a purely local tendency to the development of cancer may be inherited. Such a mode of inheritance is clearly indicated in those cases where, not only is the tendency to cancer-development in general traceable, but even to development in the same situation in the offspring as in the ancestor.

(3) EFFECT OF INJURY OR IRRITATION. Whilst the above theories relate to predisposing causes, the effect of injury or irritation may be considered as an *exciting* cause of tumour-formation. There can be no doubt, in the mind of any surgeon of experience, that the effect of injury or irritation in the causation of cancer is no mere hypothesis. How the injury acts is another affair altogether, and here it will suffice to point out merely some well-established examples of the effect of so-called *traumatism*. The occurrence of epithelioma of the lip or tongue is not infrequently preceded by the irritation of sharp teeth; of broken pipes, often very short, and consequently proportionately hot; of syphilitic or simple ulcers, or fissures, &c. Phimosis, and the consequent irritation of the glans and prepuce by retained secretion, may precede epithelioma of the penis. Sweeps' cancer results from irritation of the scrotum by soot; and other such instances will readily suggest themselves.

But, whilst long-continued irritation often precedes malignant growths, it should be especially borne in mind that it is the carcinomata that are specially likely to follow it. The occurrence of the sarcomata, on the other hand, possibly from their growing in the deeper tissues, is not materially influenced by irritations, but rather by direct and sudden injury, especially in the form of contusion. Thus, a blow on the testis may precede sarcoma of that organ, and a similar history is not uncommon in periosteal sarcomas of bone. Again, wrenches, sprains, and effusions of blood often precede the sarcomas of the soft tissues; and it is certainly to be noticed that, where the tumour is preceded by an injury, it is occasionally of a most malignant type. Further, the swelling caused by the injury in many cases does not entirely subside, but passes imperceptibly into the tumour-growth. With respect to this question of injury, it may here be pointed out that there is a definite form of tumour, allied to the sarco-

mata, which is always preceded by an injury and grows in a scar—namely, keloid. A keloid growth is composed of spindle cells and young connective tissue, and cannot be distinguished microscopically from a spindle-celled or fibro-sarcoma. It further resembles the sarcomata in the constancy of its recurrence after removal, and appears, on the whole, to be in the position of a connecting link between the sarcomata and the inflammatory new growths.

(4) PHYSIOLOGICAL ACTIVITY OR DECLINE.—Both carcinomata and sarcomata frequently occur in places where active or degenerative processes are in progress. The sarcomata are found more particularly in connection with growing and developing, or functionally active, organs or tissues—e.g. at the epiphysial ends of the long bones, in the developing kidneys of infants, in the mammary gland during the years of its greatest activity, and in the parotid gland. The carcinomata, on the other hand, are more prone to develop in glands and tissues that are undergoing retrograde changes—e.g. in the breast and uterus towards the end of the child-bearing period, or later. Normally, in such organs there is a gradual disappearance of epithelial tissue, and if by any means its growth is again induced, the epithelium seems to be unable to grow in a natural manner.

So far the various causes which have been discussed are such as may be considered of a general character. But there are certain more definite conditions which influence greatly the *nature* of the malignant growth. The chief of these are—1. Age; 2. Sex; 3. Locality.

1. *Age*.—Speaking generally, it may be said that sarcomata occur in the young and middle-aged, carcinomata in the middle-aged and old.

2. *Sex*.—In addition to those peculiarities which are dependent upon differences in the sexual organs, certain malignant growths of parts, that might be called indifferent to either sex, are very differently predisposed to tumour-formation in the male and the female. Thus, epitheliomas of the lip and tongue are much more rare in women than in men.

3. *Locality*.—Whilst some organs and localities are frequently attacked by sarcomata, the occurrence in them of carcinomata is unknown. This difference may be dependent upon the absence of any epithelium from which an epithelial growth can start, and is well instanced in the case of the long bones, for, in these, sarcomatous growths are frequent and carcinomata never occur.

On the other hand, the tongue is very rarely attacked by sarcoma, but frequently by carcinoma, although the elements for the development of each are present. Again, in two glands so nearly identical in structure as the parotid and submaxillary, one—the parotid—is frequently the seat of new growths of a malignant nature, the other but rarely. In a similar way, some bones are never attacked by sarcomata, others frequently so. Some organs—e.g. the lungs and spleen—are practically never the seat of primary cancer; others—e.g. the liver and the testis—are liable to be attacked by each of the two great classes of the malignant tumours.

Although all the preceding causes may be recognised as resulting in the production of malignant tumours, it is, nevertheless, difficult to understand the exact manner in which they act. Various explanations have been offered, but none of them are entirely satisfactory. In considering this subject, it must clearly be kept in mind that the most marked character in which any tumour differs from a simple overgrowth of the tissue is, that it grows *independently of the mother-tissue* from which it originated. Under normal conditions, the influence of the mother-tissue in determining the fate of any newly-formed cells cannot be too highly estimated, and is most clearly evident in many pathological and physiological processes. Thus, in the union of a fracture, it is the influence of the bone-tissue that causes the inflammatory exudation of leucocytes to become organised into bone; in wounds of tendons, the same influence is at work, and out of precisely similar cells tendon is formed. In the ordinary every-day process of nutrition, it is the influence of the mother-tissue that causes all growth and development to take place on the exact type of the pre-existing structure. In the growth of any tumour, but more particularly of a malignant one, it is this influence that is most notably absent. And it is readily conceivable that any given tissue or organ may, by an inherent instability of its structure, be disposed to tumour-growth, or that this instability and deficiency in control over the processes of growth or development may also be induced by any of the causes just enumerated.

But, supposing such a theory as the foregoing to be true, does it satisfactorily account for the apparently independent life of the tumour-cells, when transplanted into different organs from those in which they originated? If the cells were capable of growing in any organ to which they may

be transplanted, as they seem to be at first sight, then tumours would be certainly inoculable, either in the same animal in which they commenced to grow, or in any other into which they might be transplanted. This, however, is not the case. If a portion of a growing tumour be transplanted into another animal from that in which the original tumour grew, it never attains any appreciable size, and acts in a manner entirely different from the original growth. Further, in the case in which secondary deposits occur in one organ and not in another, when, so far as can be ascertained, each has been equally exposed, we are justified in supposing that the exemption of the one is due to the fact that its tissue yet exercises a controlling influence over all cells that may be brought into contact with it.

Are the causes, then, that excite cell-growth to be neglected? Certainly not. For had no undue cell-growth been excited, no greater strain would have been thrown on the mother-tissue than it could have borne, and it is conceivable that the very multiplicity of the cells may tend to emancipate some of them at least. In this way the effect of an injury or irritation in producing tumour-formation would be of a twofold nature. Firstly, more cells would be produced than could be controlled by a mother-tissue previously deficient in vital power; and secondly, the injury might itself inflict the necessary damage on a tissue already predisposed. In a similar manner, the development of tumours at the growing ends of bones, and in functionally active glands, may be brought about by a greater increase in the number of the cells than can be properly regulated by a mother-tissue inherently predisposed to tumour-growth.

It will thus be seen that this theory involves a predisposition to tumour-formation in any given organ or tissue. This tendency may, as already explained, be inherited or congenital, but not necessarily so; for it is conceivable that the condition of a tissue may vary from time to time, and that tumour-growth only occurs when all conditions, both exciting and predisposing, are favourable.

Moreover, this theory assists us in understanding the *recurrence* of growths. These have hitherto been explained by supposing that certain cells are left behind, and that these in the future take on active growth. Such a theory appears very difficult of belief, and is open to the same objection as Cohnheim's inclusion theory. It

is scarcely conceivable that tumour-cells should remain in any organ or tissue for five, ten, or more years—for such times may elapse between removal and recurrence—and yet maintain their own individuality; besides, it is noticeable, in the sarcomata, that the cells of the secondary growth often differ materially from those of the primary one. It is much more likely that a sufficient amount of the surrounding mother-tissue is not removed, and that the same or a similar process of emancipation of cells from its influence again takes place as that which resulted in the production of the original tumour. Thus, when a carcinoma of the breast is removed, if the whole of the gland be not taken away, we know that the growth is much more likely to recur than if the operation had been a thorough one. The explanation of this would be that the whole gland was predisposed, and it was the influence of the remaining diseased part that reproduced the tumour.

Treatment.—There is but one treatment for a malignant growth—namely, removal. When once the diagnosis has been made, all palliative treatment must be abandoned. As a rule, removal should not be attempted unless (a) the whole of the disease can be taken away, unless (b) the glands are not too extensively affected to admit of similar radical treatment, and unless (c) there is reason to believe that no metastatic growths are present in the viscera.

In speaking of treatment, it is well also to mention that in not a few cases the development of malignant tumours can be obviated. Thus, no ulcer of the tongue, caused by either a sharp tooth or by syphilis, should be permitted to remain unhealed; increase in size of a previously quiescent wart or mole should be met by immediate excision; and whenever any reasonable doubt exists as to whether any given swelling is inflammatory or due to malignant growth, an exploratory operation should be undertaken without unnecessary delay, and if the case still remain doubtful, removal should certainly be recommended.

Treatment of Growths in Lymphatic Glands.—In all cases where the glands are evidently affected, they should, if possible, be removed. Such operations are often difficult, and, in their performance, the surgeon is liable to be led into much deeper and more dangerous regions than he might expect from an external examination of the growth. The frequency with which carcinomas in some localities affect the glands (especially carcinomas in the breast and on the lip and tongue), has caused some sur-

geons to advise that in all cases of carcinoma in such regions the glands in the neighbourhood should be removed. It is certainly true that, even where no diseased gland can be detected by the most careful manipulation, there may be nevertheless considerable glandular disease. Thus cases are not infrequent in which glands, hardened and enlarged, have been detected only after incision of the superjacent skin and fascia. And, in other cases, glands which, before being cut open, when handled free from the surrounding tissues, appeared entirely normal, have on section been found to contain minute masses of epithelial cells. Indeed, it is evident that, where the cancerous deposit is yet microscopic in amount, it cannot be detected by the naked eye. It follows, therefore, that in no case can it be certainly stated that the glands are not the seat of secondary growth.

Excision of a malignant tumour with a knife or other cutting instrument is the most usually applicable method of removal, the advantages being that a clean-cut surface is left, that the amount of tissue to be removed can be readily regulated, and that the whole operation is completed at once and painlessly.

Removal by caustics is not now so much resorted to as formerly, but there are not a few patients who will submit to the use of these agents, yet who will not tolerate a cutting operation. For such, this method is often applied with benefit, although otherwise, except in rare instances, it has no advantage over excision with the knife.

Electrolysis is useful in cases similar to those in which caustics may be used.

Prognosis after Excision.—From what has been already written in an earlier part of this article, it may be gathered that the prognosis varies according to the nature and situation of the new growth. No general rules are applicable to all cases.

Question of Partial Removal.—The question not infrequently arises whether an operation should be done, when it is evidently not possible to remove entirely either the original tumour or else the secondary growth in the glands, more especially in those cases where the patient suffers great pain, or where there is a large fungating and foul-smelling tumour. There can be no doubt that, in many such cases, partial operations are both justifiable and advisable. See CARCINOMA; SARCOMA. W. MORRANT BAKER.

ANTHONY A. BOWLBY.

MAMMARY ABSCESS. See BREAST, Diseases of the.

MARTIN'S BANDAGES are made of pure rubber, and are quite free from sulphur. They are used to exert pressure on tissues which are indurated owing to long-continued chronic inflammation and passive congestion, to compress joints and bursæ which are the seats of chronic effusion, and to support varicose veins; for the latter purpose they are admirable substitutes for elastic stockings.

Rubber bandages are largely employed in the treatment of callous ulcers of the legs, either to support varicose veins, if there be any, or to promote the absorption of the chronic inflammatory products in the edges of the ulcers. The bandages should be worn during the day only, and should be placed in direct contact with the sore; at night, the bandages should be removed and a simple dressing, free from grease, should be applied to the ulcer. The india-rubber bandages are spoiled by grease, so it is most important that ointments should not be used in combination with them. The bandages must be kept very clean; when removed at night, they should be well sponged with tepid water and then hung up to dry. In the morning, before the patient gets out of bed, the leg and ulcer should be washed and dried; the bandage should be applied in a simple spiral from the ankle to the knee, and care must be taken that it is laid on evenly, and only as tightly as can be done without stretching the bandage. When the patient gets up the leg will swell a little, and so stretch the bandage sufficiently to obtain all desirable compression.

The india-rubber bandages retain the perspiration, and the latter is often irritating enough to cause an attack of eczema in a tender skin; should this happen, the bandage must be discontinued and the eczema treated. The bandage may be subsequently tried cautiously, and it may be found that the leg has become tolerant of it.

As a support to varicose veins, the bandage must be applied as above described.

The bandages may be obtained in lengths varying from three to twenty-one feet; in breadths of two and a half or three inches, and in three different gauges of thickness.

BILTON POLLARD.

MASON'S SPLINT for excision of the elbow consists of two pieces of perforated metal, moulded to fit the upper arm and forearm respectively, and so jointed as to permit the movements of flexion and extension at the elbow and of pronation and supination of the forearm. The splint

should be applied to the inner side of the limb. Within certain limits it is possible to adapt it to the size of the limb for which it is required.

MASSAGE or SHAMPOOING. —

Definition.—Massage consists of a more or less forcible kneading, pressure, or alternate compression and relaxation by the operator's hands, of the soft tissues of any part of the patient's body. Movement or manipulation of the joints is not included. See MEDICAL GYMNASTICS; BONE-SETTING.

Much mystery has generally been associated with the art of rubbing, from the fact that till recently few medical men have practically studied it. Hence, it has been too often left in the hands of so-called 'professional' or 'medical rubbers,' each of whom has been allowed to do as he liked, even when employed by a medical man.

Object.—In most cases, massage is employed to improve local nutrition in a wasted limb, to increase the circulation when languid, and to accelerate the re-absorption of effused products, the result of inflammation or chronic congestion.

Physiology.—Massage induces a more rapid flow of the blood and lymph in any given region of the body; this is chiefly due to contraction from irritation, followed by relaxation of the capillaries and smaller blood-vessels which are controlled by the vaso-motor nervous system, but no doubt the mechanical pressure has a direct influence on the larger veins and lymphatics. By perseverance with friction for a few minutes, the previously cold and clammy limb can be made to glow with natural warmth, an effect which will last for hours in some cases, in others for a few minutes only. If sufficient pressure is exerted in the rubbing, not only the skin and subcutaneous tissues are influenced, but also the deeper lying organs, as the muscles, &c. Rubbing is also employed in chronic constipation due to deficient peristaltic movements of the bowels.

Classification.—Massage has to be modified according to the effect it is desired to obtain, and can be roughly classified as follows:—

(a) For deficient or languid circulation, œdema, and chronic congestions of the extremities.

(b) For muscular paralysis or paresis.

(c) For perverted action or inactivity of the skin.

(d) For chronic thickenings around diseased or injured joints.

(e) For chronic constipation or obstruction of the bowels.

(f) For the relief of pain.

(a) *For deficient or languid circulation*, nothing is more efficacious than the manipulation known as 'fulling'; it is effected by a rapid, transverse, to-and-fro gliding of the two palms alternately on opposite sides of a limb, which is at the same time as firmly compressed as possible. If the leg is to be 'fulled,' the operator begins close to the groin and gradually works his way down to the foot, rapidly moving the hands to and fro. The first time, the hands should be on the outer and inner aspects of the leg; the next, they should be placed higher on one side and lower on the other; the third time, this position is reversed; and finally, the hands are placed anteriorly and posteriorly to the limb. The patient must let the limb remain perfectly passive, so as not to resist the manipulation. 'Fulling' is done either on the bare skin or through some thin underclothing. In chronic congestions and œdema of the extremities, *firm strokings upwards* with the palms, used alternately, are useful; here the skin must be protected from abrasion by olive oil, vaseline, &c.

(b) *For muscular paralysis or paresis*, several manipulations are employed. 'Kneading' is a combination of grasping with large pinching and pressure by the two hands, used alternately, so that whatever is left of the wasted muscles is thoroughly squeezed and moved about. In 'kneading,' the four fingers kept close together should act as one, against the thumb and its thenar mass; care must be taken really to reach the muscles by exerting sufficient pressure, at the same time that the skin is not unduly pinched so as to cause pain. In treating adults, the operator's labour is facilitated if he throws his weight into each grasp of the hand.

'Circular friction by the thumb' is most useful when the space occupied by the wasted muscle is small, as in the case of the anterior tibial muscles, or of those on the anterior and posterior aspects of the forearm, &c. It is, however, equally efficacious for large muscles, as the quadriceps extensor of the knee or the glutei. The operator's thumb-end is firmly placed on any given spot, and, while considerable pressure is exerted, small circles, a half to one inch in diameter, are described ten times from right to left and ten times from left to right. A spot an inch higher or lower, or to one side, is then treated in the same way, and so on until every part of

the muscle or group of muscles has been thoroughly manipulated. The pressure exerted by the thumb can be increased, if necessary, by placing the other thumb on its nail. The skin must always be protected from abrasion as already described. The muscles of the forearm or the anterior aspect of the tibia require from ten to fifteen minutes to be thoroughly rubbed by this method.

Tapping or beating muscles with india-rubber hammers or flat-headed wooden sticks, much employed on the Continent, is less efficacious than the human hand properly instructed.

(c) *For perverted action or inactivity of the skin*, simple rapid to-and-fro frictions with the palms, with or without oil, employing but slight pressure, are easily carried out.

(d) *For chronic thickenings around diseased or injured joints*. — Upward 'gliding friction' firmly applied with the palms and fingers around the whole joint, following its contour and the course of the adjacent tendons, is most beneficial; here also the skin must be protected by oil, &c. Fifteen to twenty minutes should be devoted daily to a large joint such as the knee.

(e) *For chronic constipation or obstruction of the bowels*, massage is most useful when the large intestine is at fault. The patient should lie on the back with the head and shoulders well raised, and the hips and knees flexed and supported by pillows so as to relax the abdominal walls as far as possible. A thorough kneading of the whole abdomen is then easily done, by the operator's hands alternately grasping and relaxing as large a portion as possible of the abdominal walls and the underlying intestines, one hand following the other as in kneading dough. To act specially on the colon, its course should be followed by the palms, which, while exerting considerable pressure, should glide upwards from the right iliac region to the right ribs, then transversely across the epigastrium to the left flank, and then down to the left iliac region; after a little practice, the left hand ascends, the right hand crosses and the left hand descends with great ease and rapidity, especially if the abdomen is covered by the night-dress. The operator should stand on the right side of the patient.

(f) *For the relief of pain*, firm 'stroking' from above down with the flat palms, used alternately, is always soothing. Nearly all the previously described manipulations

are best ended by a score or two of such firm strokings.

General remarks.—As a rule, the patient should feel more comfortable and rested after being rubbed, and the infliction of pain must be avoided if possible. In fat patients, bruising of the skin frequently occurs, but is of no consequence. In some affections, especially in infantile paralysis, the patient will often for the first week or two, or longer, complain of considerable pain while being rubbed, but afterwards the discomfort gradually ceases, and the rubbing will become, on the contrary, actually comforting and soothing. To effect a good result, massage for a half to one hour, once or twice daily, must be persevered with for at least a month or longer. An intelligent nurse or friend of average strength can be readily taught all the above manipulations in one or two *séances*. BERNARD ROTH.

MASTOID CELLS, Suppuration in the. See EAR, MIDDLE, Diseases of the.

MASTURBATION has been defined as 'the production of the sexual orgasm by unnatural means.' Although this vicious habit is one indulged in by both sexes, it is more particularly in males that the surgeon is called upon to interfere. In the case of young children, the irritation of a long prepuce or even the accumulation of discharge beneath it, often leads to manipulation of the parts, and thus lays the foundation of the habit. When it is suspected, the child should be stripped and watched for a few moments, when in all probability the hand will stray to the genitals and unconsciously manipulate them, causing an erection of the penis. But when this is not observed, undue elongation of the prepuce and unnatural development of the parts should lead to the suspicion that, even at a very early period of life, masturbation may have become an unconscious habit. The remedy at this stage is circumcision, and fortunately it is generally a radical cure, for not only is the cause of irritation removed, but the soreness consequent on the operation prevents the child from manipulating the parts, and thus the habit is broken through.

The same treatment applies to much older children. But the cure in their case is not so certain or so immediate, and a recurrence to the practice as soon as the penis is sound should be watched for; on the least suspicion the penis should be freely blistered, and this should be repeated until the practice is entirely discontinued. Excessive masturbation, in children of about nine or

ten years of age, sometimes leads to serious consequences, amongst others the occurrence of epileptic convulsions. It is a fact that the convulsions will entirely cease after the operation of circumcision, and recur so soon as the patient has recovered from that operation, indicating no doubt a resumption of bad practices. At a later period of life, amongst lads who are approaching puberty, the surgeon has frequently to deal with cases of self-abuse. Too often the habit has been learned at school, and has been indulged in without knowledge either of its sinfulness or evil effects. It is a serious question how far this acknowledged vice in schools might be prevented by timely warning, given either by the parent or the medical attendant, to the lad before embarking on school life. Be that as it may, it is certain that the surgeon has often to deal with cases in which the habit has become inveterate and most difficult to break through.

In young adult life, sometimes the discovery is made on the confession of the patient, who has been probably alarmed by reading some filthy quack publication on the subject. In such a case it is the surgeon's duty to allay the unreasonable alarm of the patient, holding out to him confident hopes of ultimate cure. It will be found, in very many cases, that the occurrence of nocturnal emissions is the prominent symptom which arouses the patient's fears. In the first place, he should be convinced that within certain bounds these are not harmful. He should then be instructed to avoid, if possible, turning on his back during sleep, and the old-fashioned plan of fixing a cotton reel over the lower part of the spine, thus awakening the sleeper if he should turn over on his back, is not to be despised. If possible, he should get into the habit of voiding his urine in the early morning hours. The application of nitrate of silver to the prostatic urethra is also of service, as also the passage of a full-sized metal bougie. All these plans, combined with careful attention to the general health, cold bathing, good exercise, and the cultivation of pure morals, will help the patient to emerge from the despair in which this unhappy habit has plunged him; and, if an immediate cure be not effected, at any rate his mind will be impressed with the idea that active measures are being taken for his restoration. See SPERMATORRHOEA.

In more advanced cases, where the habit has been long confirmed, the constitution thoroughly undermined, and the mental powers impaired, it becomes a question

whether the mental condition is not the incentive rather than the result. Self-abuse amongst the insane is a well-recognised fact, and it is also understood that the period of puberty is fraught with danger to those who have inherited mental infirmity. It can be, therefore, readily believed that, in these extreme and apparently hopeless cases of masturbation, insanity is at the bottom of the disease. From a surgical point of view, little can be done. Constant blistering of the penis is about the only course to be adopted, and that, it is to be feared, affords at best only a temporary alleviation. Vigilant supervision, especially at night, which can hardly be obtained outside the walls of an asylum, and the use of locked gloves are also essential. The administration of bromide of potassium has been much advocated, but in the majority of bad cases it will be found of little use. PAUL SWAIN.

MAXILLA, SUPERIOR, Fracture of the. *See* FACE, Fracture of Bones of the.

McINTYRE'S SPLINT is a double inclined iron trough, adapted to fit the back of the thigh and the upper two-thirds of the leg; below this the splint is continued as two side-pieces, with slots in them along which the foot-piece may be moved. The foot-piece can be firmly fixed at the place desired, and the angle at the knee can be increased or diminished as required.

MEATUS AUDITORIUS. *See* EAR, EXTERNAL, Diseases of the.

MECKEL'S GANGLION, Removal of. *See* NERVE AVULSION; NEUROTOMY.

MEDICAL GYMNASTICS.—Gymnastics were first scientifically applied in the treatment of disease by Peter Henry Ling, a Swedish patriot, who died in 1839. He devised a system of exercises, based on anatomy and physiology, by which every voluntary muscle or group of muscles in the body could be brought into action. Ling classified all exercises into—(1) *Active*, which were motions effected by a voluntary effort of the patient; (2) *Passive*, which were those executed on the patient by the surgeon or trained assistant; and (3) *with assistance*, constituting an intermediate class which were partly active and partly passive; thus, in a partially paralysed limb, there may be still some voluntary contraction left in a given muscle, but not sufficiently strong to flex or extend its joint without the help of a second individual. For further information on *Passive* exercises, *see* MASSAGE.

During the voluntary contraction of a muscle, the patient may overcome a yielding resistance offered by the surgeon's hand, or the patient can resist, gradually but continuously giving way, while the surgeon slowly elongates the previously contracted muscle. Thus, taking the biceps and brachialis anticus muscles of the arm, the surgeon can resist by holding the wrist, while the patient slowly flexes the previously extended elbow, which is described as 'surgeon resisting' (S. R.). The flexed elbow can be slowly extended again by the surgeon, while the patient continuously resists and gradually yields; this is described as 'patient resisting' (P. R.). In some exercises the weight of the limb or part moved is, at first, a sufficient resistance. After the power of the weak muscle has been improved by exercise, greater work is obtained by S. R. or P. R. It has been thought that in some cases S. R. exercises are indicated rather than P. R. ones, but, so far as the writer's experience goes, the difference in efficacy, if any, is slight.

Medical gymnastic exercises should be done slowly, without any sudden jerking, and the patient's respiration should continue regularly the whole time. When P. R. or S. R. exercises are practised, the patient should count slowly aloud one, two, three, &c., which prevents him holding his breath, and obviates all risks of hernia, strains, or other injury from unaccustomed movement.

A brief description of 'medical gymnastic' exercises which are useful to the surgeon will be given, all of which can be carried out without special apparatus by the employment of a little ingenuity. For the medical gymnastics of the spine and thorax, *see* ANTERO-POSTERIOR SPINAL CURVATURE; LATERAL SPINAL CURVATURE; PIGEON-BREAST.

ANKLE-JOINT.—The patient sitting, has the leg supported on a chair with the foot projecting beyond. *Flexion*, *extension*, *adduction*, *abduction*, and *circumduction* are executed either voluntarily by the patient or passively by the surgeon; if the former, when the patient is strong enough, also with S. R.

ELBOW-JOINT.—The upper arm being fixed by the surgeon against the table on which the patient lies, *flexion* or *extension* is easily resisted by the surgeon's other hand, the elbow being either flexed or extended to begin with. *Pronation* and *supination*, also *flexion* and *extension*, of the Wrist present no difficulty, if a little time and attention are devoted to carrying out

similar exercises to those already described. The same remarks apply to *flexion, extension, &c.*, of the individual *Fingers*.

Each movement should be repeated some six to twelve or twenty-four times, according to circumstances, and about three-quarters to one hour daily be devoted to the treatment in order to obtain satisfactory results. Throughout all these exercises, care should be taken that, when the patient is trying to contract (i.e. exercise) a muscle, he is not allowed to involuntarily contract other stronger or normal muscles, which should remain at rest.

HIP-JOINT.—The *extensors* (glutei) are efficiently brought into action by the patient lying prone and slowly raising the leg, with the knee kept extended, from off the ground or table on which he is lying. In this same position, *circumduction* of the hip, from right to left and *vice versa*, is easily done. At first, sufficient resistance is offered by the weight of the limb; later, as the patient gains in strength, the severity of the exercise can be increased by the surgeon's hand pressing downwards against the back of the heel (S. R.), or by placing a double bag of shot over the tendo Achillis, a weight of from two to five or ten pounds being generally sufficient. The *abductors* of the hip are obliged to work by the simple expedient of making the patient lie on his side, and do the hip-circumduction with the uppermost leg. The *flexors* are exercised while the patient is lying on his back with the knee extended, either voluntarily or by a lightly applied back-splint. *Inward and outward rotation* of the hip are too simple to require description.

KNEE-JOINT.—The *quadriceps extensor* muscle is made to contract while the patient, lying supine, has the knees flexed, and the legs hanging vertically over the end of the padded table on which he lies. One knee is slowly extended; if the weight of the leg is too great, the surgeon assists by partially supporting the foot, while the patient voluntarily performs as much of the movement as he can. The *flexors* are brought into action by the patient lying prone, and trying to raise the foot from off the ground by slowly flexing the knee, with S. R., if necessary, applied to the back of the heel.

SHOULDER-JOINT.—*Circumduction* from before backwards, which brings nearly all the shoulder and scapular muscles into play, is best done while the patient is lying supine on a padded table, the elbow and

wrist being kept extended either voluntarily, or, if that is impossible from weakness of their muscles, by means of a light anterior wooden splint.

To bring the *scapular* muscles into action, the patient should lie supine, with the arms carried down by the sides of the trunk, or abducted at right angles to the body, or extended upwards by the sides of the head; he has to resist the arms being brought forwards by the surgeon (P. R.) from one of the above commencing positions, and then slowly to return them to the initial position against the surgeon's gradually yielding resistance (S. R.). The elbows are to be kept well extended the whole time, as described above, and the surgeon should grasp the patient's wrists. The rhomboidei and subscapularis muscles are chiefly brought into action in the second movement, with the arms at right angles to the trunk.

BERNARD ROTH.

MEDICINAL ERUPTIONS.—Many drugs and chemicals give rise to eruptions, sometimes after being taken in medicinal doses for a considerable period of time, when the system may be supposed to be saturated with them; sometimes they occur after a single dose has been taken, betraying a peculiar susceptibility on the part of the patient (idiosyncrasy).

1. *Iodine, Iodide of Potassium, and other Iodides* may give rise to—(a) erythematous patches ('iodic roseola') on various parts; the eruption may pass into a papular form, with large disseminated papules, slightly elevated, seated on a reddened surface, the whole not unlike urticaria; (b) purpuric eruptions, often assuming a petechial form, especially affecting the legs; (c) vesicular eruptions (rare), said to resemble eczema; (d) bullous eruptions on the head, neck, and upper extremities, the bullæ tending to be hæmorrhagic; (e) pustular eruptions resembling those produced by bromides.

2. *Bromine, Bromide of Potassium, and other Bromides.*—(a) An erythematous eruption; (b) a maculo-papular eruption closely resembling a syphilide; (c) a bullous hæmorrhagic eruption; (d) pustular, acne-like eruptions, usually on the face or chest; also an eruption which has been described as confluent acne. At its height, it is characterised by round flattened elevations covered with moist epidermis, not unlike that in condyloma, or with thick brownish crusts, on removing which the surface is seen to be dotted with minute collections of pus; the lesions are surrounded by a dark-red areola,

3. *Belladonna* may give rise to an eruption partly erythematous, but partly scarlatiniform—i.e. minutely punctate. It occurs in sharply defined palm-sized patches, which usually affect the upper part of the body; there is no burning or itching complained of, and desquamation does not follow.

4. *Chloral*.—An erythematous patchy eruption, with heat and itching, chiefly affecting the neck, front of the chest, the larger articulations, and backs of the hands and feet. Urticarial, papular, vesicular, and purpuric eruptions have also been described.

5. *Copaiba*.—The eruption generally takes the form of a roseola, selecting the hands, arms, feet, knees, and abdomen. The lesions are slightly raised to the touch, and, being in some instances isolated, may resemble urticaria; itching is present, and the skin may smell of copaiba. The eruption is sometimes taken for macular syphilis.

6. *Cubebs* may give rise to a similar eruption, but it is more generalised and does not itch.

7. *Quinine*.—Erythematous, papular, urticarial, and purpuric eruptions have been noted.

8. *Salicylic Acid*.—(a) Diffuse erythema, with œdema of the eyelids; (b) vesicles and pustules on hands and feet; (c) purpuric eruptions.

9. *Tar, Carbolic Acid, Turpentine, Resin*.—A general erythematous urticarial eruption has followed Lister's process. Turpentine produces a similar eruption with great itching, preferring the face and upper portions of trunk. Eruptions have been noticed to be caused by other drugs, as arsenic, cannabis indica, digitalis, mercury, opium, santonin. ALFRED SANGSTER.

MEDULLARY CANCER. See CARCINOMA.

MEIBOMIAN GLANDS, Affections of the. See EYELIDS, Diseases of the.

MELANOSIS. See SARCOMA; MALIGNANT TUMOURS.

MELASMA. See CHLOASMA.

MEMBRANA TYMPANI, Puncture of the. See EAR, MIDDLE, Diseases of the.

MEMBRANA TYMPANI, Rupture of the. See EAR, MIDDLE, Diseases of the.

MENINGITIS. See ENCEPHALITIS.

MENINGOCELE.—By this term is meant a hernia of the membranes of the brain through some part of the parietes

of the cranial cavity. The sac consists of dura mater and arachnoid, with a covering of skin. Occasionally an interval (subdural), more or less considerable, exists between the two membranes, or, on the other hand, they may be so fused together that it is difficult to differentiate the wall of the sac into two distinct layers, especially at that part most remote from the opening in the skull. Hence, possibly, the presence of arachnoid has been overlooked in those rare instances in which the sac has been described as being formed of dura mater alone. Mr. Bryant mentions such a meningocele as being in Guy's Museum, No. 1563⁶⁰; but on examining this specimen a considerable protrusion of arachnoid is visible, which is disposed in loose folds at some distance from the dura mater. This separation of the two membranes is probably due to the way in which the preparation was mounted when fresh. Mr. Shattock states that after careful inspection of many cases of spina bifida (the analogous condition in the spinal region), he could not say that the arachnoid membrane was ever absent. Although it is conceivable that the wall of a cranial meningocele might be formed of dura mater alone, it does not appear probable that this ever happens.

The hernial sac is distended with cerebro-spinal fluid, and sometimes contains a part of the brain or cerebellum. In the latter case the tumour is known as an *encephalocele*; and if a case of encephalocele be complicated by the co-existence of a hydrocephalic state of the ventricles, then the term *hydrencephalocele* is employed. These tumours are always congenital, are more frequently met with in male than female children, and are due to an arrest of development of the bony wall of the cranial cavity at the point at which they appear. They vary from the size of a marble to two or three times the size of the head of the child; in fact, they may be so small as not to attract attention or so immense as to produce almost complete exencephalia. In the *Pathological Transactions*, vol. xvi., the late Dr. Murchison related a case in which the whole of the cranial portion of the occipital bone was deficient, causing an enormous bag to depend from the back of the head, containing the whole of the brain except a portion of the thinned, expanded, and stretched out anterior lobes, which alone occupied the diminished cranial cavity.

The most usual seat of these tumours is in the median line, especially in the occipital region. They may, however, occur at any other point, as through the frontal suture

or the fronto-nasal suture, in the temporal region, or dipping down into the nasal cavity or pharynx. In the last-named situations they have been mistaken for polypi. Statistics illustrate the frequency with which these malformations occur in the occipital region. The mode of development of the tabular portion of the occipital bone is worthy of note in connection with this point. It is developed from four nuclei, which appear about the eighth week of foetal life. At birth this tabular portion consists of a flat plate, with fissures running in nearly to the centre from the upper, lateral, and lower angles. It is by the persistence and exaggeration of the two fissures in the median line that these hernial protrusions occur so often in the mesial part of the occipital bone. The upper fissure is the last to close; the lower, or that below the occipital protuberance, is almost obliterated at birth. Hernia does not seem, however, to be more common above than below the occipital eminence. In the museum of St. Thomas's Hospital there are two specimens of meningocele, about the size of a walnut, which each communicate with the cranial cavity by means of an oval foramen nine lines in length, situated below the occipital eminence; and one specimen of encephalocele, about the size of an orange, containing part of the cerebellum, and communicating with the cranial cavity by means of a foramen of similar dimensions and relations. The continuity of the lower fissure with the foramen magnum may explain the frequency of hernia below the occipital protuberance, for in many instances this fissure opens out to form with the foramen a huge opening, bounded behind and laterally by the rudimentary exoccipital and supra-occipital elements of the occipital bone. Through this opening the cerebellum commonly passes out into the cavity of the protrusion.

These tumours when large have the skin tightly stretched over them, are of a pink or bluish colour, and, if fluid, readily transmit light. They may or may not be pedunculated; and the tension of any individual tumour may be so great as to interfere with the discovery of the bony margins of the opening in the skull. The same difficulty will be experienced when much solid matter is present. When the tumour is small, it may be reducible by gentle manipulation; but pressure is very apt to set up signs of cerebral disturbance. This fact is of the greatest importance in the diagnosis between the various forms of congenital tumour occurring in this region—between

meningocele and encephalocele on the one hand, and large subcutaneous nævus and dermoid cyst, with or without involvement of the bony vault, on the other, especially when these tumours occur exactly in the median line. It may be noted that nævi and dermoid cysts occasionally make their first appearance a few days after birth. The pulsation of an encephalocele is synchronous with the pulse in the arteries, and clenches the diagnosis of this variety of hernia. Pulsation may, however, also occur in the case of simple meningocele, when there is a large communication between the cavity of the cranium and the cavity of the protrusion. In rare cases, the dura mater is exposed in whole or part without a covering of skin, or there is an ulcerated surface over the centre of the tumour indicating that the dorsal laminæ have not completely closed, so that no epiblast is present from which skin could be produced at the ulcerated spot.

The excess of cerebro-spinal fluid is contained in the expanded subarachnoid space, or in the dilated ventricle, or more commonly occupies both situations. Hydrocephalus externa never exists as an independent affection, but may occur from rupture of hydrocephalic ventricles or as a consequence of large arachnoid hæmorrhage, &c. In ordinary hydrocephalus (hydrocephalus interna) the fluid is limited to the dilated ventricular cavities, and its increase in quantity is intimately dependent upon an inflammatory condition of the lining membrane of the ventricles, which are generally imperfectly developed. Possibly also there is some connection between excess of ventricular fluid and the presence of tubercles or other tumours, which either mechanically interfere with the passage of blood along the veins of Galen, or obstruct the foramina in the pia-matral expansion covering in the lower part of the fourth ventricle, whereby is inaugurated a disturbance of pressure equilibrium within and without the brain. In cases of meningocele and hydrencephalocele, the common association of an excess of fluid in the ventricles with an excess of fluid in the subarachnoid space points to the fact of these conditions originating from one common cause.

When a meningocele is small, the *diagnosis* may generally be cleared up by attention to the following points:—1. The attachment of the tumour to the bone, and its position in the median line. 2. Its congenital nature. 3. Its fluid character—the tension of the cyst increasing during crying, coughing, and other expiratory acts.

4. Cerebral pulsation may or may not be present. 5. The hernia may be partially or wholly reducible, with or without the production of cerebral symptoms. 6. Palpation of the deficiency in the wall of the skull.

Cephalhæmatoma, or a collection of blood between the pericranium and bone, takes place usually over one of the parietal bones. It is limited to one bone by the union of bone and pericranium in the neighbourhood of the sutures, and disappears a short time after birth. A meningocele of the parietal region is rare. Cases have been published of simple fracture of the skull, generally of the parietal bone, in infants, followed by *pulsating tumour*. A cephalhæmatoma forms immediately after the injury, but, the brain membranes being torn as well as the brain-case fractured, cerebro-spinal fluid, and sometimes brain-matter, passes through the rent into the cavity of the blood tumour. Any interval from forty-eight hours to many days may elapse between the formation of the typical cephalhæmatoma and its assumption of pulsatile qualities. The wall of the original blood-tumour becomes in fact the sac of a meningocele or encephalocoele, which must be treated on the same principles as the congenital variety, but could hardly be mistaken for the latter unless the injury were to happen immediately after birth.

A *dermoid cyst* of the scalp is immovable, tense, non-pulsating, fluctuating, not changing with respiratory movements, and occurs most frequently near the outer angle of the orbit. The diagnosis presents, in rare cases, insuperable difficulties, see the interesting case published by Mr. Arnott in the *Pathological Trans.*, vol. xxv.

A *subcutaneous nævus* has no definite margin, increases in size during expiratory efforts, has a doughy, worm-like feel, imparts a bluish tint to the skin over it, is not perfectly fixed, and is not infrequently placed over one or other of the fontanelles.

An *Encephalocoele* appears generally as a small lobulated globular or oval tumour, which pulsates synchronously with the arteries. Mr. Gould has narrated a case, in which pulsation was not evident until the tumour had been partially reduced. Pulsation may not be present; therefore, absence of pulsation must not be relied upon as indicative of the absence of brain-matter in the sac of the hernia. The brain-substance in the tumour can be easily palpated through a layer of fluid. If the sac is very large, and has a broad base, the tumour is always a hydrencephalocoele, and is associated with great deficiency of the bony boundary

of the cranial cavity. In other cases, huge pedunculated sacs may be attached to the occipital or frontal regions, and contain more or less of the proper contents of the cranium. Associated with meningocele and encephalocoele may be other malformations, as hare-lip, cleft-palate, talipes calcaneus, spina bifida either affecting a portion or the whole length of the spinal column, a permanent bulbus arteriosus, as in a remarkable case placed on record by Mr. Heath, or indeed any other condition due to an arrest of the developmental processes.

Prognosis.—These malformations when large may seriously impede delivery, may interfere entirely with the life of the child, or make its prolonged existence improbable or impossible.

Treatment.—If the hernia were small, and the opening in the skull of corresponding size, it might be possible to keep it reduced so that, as the bones ossified, a cure would result. Cases have been recorded in which iodine injection, ligature of the pedicle, or even slicing off the tumour, has been more or less successfully practised. The effect likely to ensue from ligature of the pedicle can, of course, be determined by temporary compression of the neck of the sac. None of these methods are warranted by what we know of the pathology of the disease. Non-interference is the golden rule, except when the tumour is rapidly increasing in size and the life of the patient is in great jeopardy. Under these circumstances it is justifiable to resort to the operation of tapping. In a large hydrencephalocoele of the vertex, seen by the writer some years ago, Sir W. MacCormiac tapped the tumour by means of a capillary trocar connected with a very long and fine tube—gentle pressure and support meanwhile being adjusted to the head. The patient was seven years old, lived for twenty days after the operation, and then died in convulsions. Unfortunately, it is just in those cases in which it is justifiable to interfere that least can be expected from surgical operation. When a peduncle is present, and the tumour is a simple meningocele, the case might terminate happily by the recovery of the child after accidental blocking and sloughing of the peduncle. Operative interference of any sort is out of the question in cases of encephalocoele. The cure of certain meningoceles may, however, be attempted by means of the injection of Morton's fluid, which is employed with such success in the treatment of spina bifida; those cases are most likely to be successfully treated in this way which are of medium size and

pedunculated. Lately, a case has been reported as cured by the injection of Morton's fluid into the cyst-wall, or rather externally to the cyst-wall. The mental condition of the child would have an important bearing on the answer to the question whether an operation was advisable. The almost constant co-existence of hydrocephalus or malformation of the brain with hernia of the contents of the skull, renders futile, as a rule, any attempt at treatment. The best and often the only thing the surgeon can do is, by suitable means, to protect the protrusion from pressure or injury. *See SPINA BIFIDA.*

CHARLES A. BALLANCE.

MENTAGRA. *See* SYCOSIS.

METASTASIS.—By metastasis is generally understood the subsidence or disappearance of inflammation in one situation, with its coincident onset at another.

The morbid states in which it is best exemplified are—(1) pyæmia, (2) gonorrhœa, (3) gout, (4) mumps. In pyæmia and gonorrhœa the disease is primarily local; in gout it is at first general, with subsequent local expression; whilst in mumps there is some doubt whether the initial infection consists in a contamination of the blood or of the parotid glands. Many theories have been advanced to account for the phenomena in question—some fanciful, others well-grounded.

With regard to *pyæmia*, it may be stated with confidence that there are several methods by which metastasis is established. (1) A large number of the so-called 'multiple circumscribed abscesses' beyond all doubt owe their origin to embolic infarction. Portions of disintegrated venous thrombi, on being detached, are swept along by the blood current until they arrive in vessels too small to allow of their transit. The septic nature of these thrombi is incompatible with resolution of the inflammation; purulent softening is certain if the patient survives sufficiently long for its development. (2) The decomposed products of the primary local phlegmon are conveyed by the lymph channels, until they meet with some mechanical obstacle to their passage, and thus a concentration of the poison is effected; or, without this hindrance, they light on tissues already diseased or predisposed to inflammation, which then 'become acutely affected as a result of the general febrile disturbance.' In some instances, the lymphatic tracts connecting the primary and secondary foci show no naked-eye signs of reaction to the irritant that has traversed

them, but as a rule the reverse obtains, especially when the superficial vessels are involved—e.g. in a poisoned wound of the skin with consequent bubo. (3) Microscopical examination has shown that, in the true infective processes, minute organisms—cocci—multiply with great rapidity in the lymphatics and even in the blood capillaries, which become blocked with the accumulated growth. The vital activity of these bodies varies with the soil in which they vegetate. In some parts it is feeble and transient, in others it is marked and long-abiding. Hence the variation in the result, and the explanation of distant suppurative centres connected by a continuous chain of vegetation. (4) The 'secondary abscesses' may depend upon a general blood-infection, and not stand in *immediate* causal relation to the primary lesion. Of this nature are the diffuse metastases met with in the lungs, joints, and connective tissue in some cases of septicæmia—septic infection. (5) Prior to the enunciation and proof of the foregoing ways and means of metastasis, it was the custom to suppose the incidence of the secondary change to be largely due to the reflex action of the nervous system; an explanation at once imaginary and insufficient, and, as is now known, in most, if not in all, cases demonstrably contrary to fact.

What has been said respecting general pyæmia applies in much the same manner to *gonorrhœa*. At first sight, it seems somewhat curious that inflammation of the epididymis and testicle should follow acute purulent urethritis, after so long an interval has elapsed from the original inoculation; but it must be borne in mind that it takes some time for the inflammatory action to spread along the lymphatics from the urethra to the testicle, and this is one mode in which the metastasis is effected. Gonorrhœal epididymitis or orchitis, pathologically considered, is, in the writer's opinion, primarily and essentially a lymphangitis. On the other hand, the infection may be conveyed by the spermatic tract itself, and this is probably the case when the vas deferens and epididymis are much swollen and indurated, with but little thickening of the cord. *Gonorrhœal rheumatism* is generally taken to be a mild form of pyæmia in subjects predisposed to the action of the poison. The fact that a specific 'coccus' is supposed to be always present in the urethral discharge lends weight to this theory.

The metastases in *gout*—as, e.g., when severe stomachic derangement suddenly supervenes on the equally rapid subsidence of an attack of arthritis—are either merely a

series of phenomena having no causal relation one with another, or, what seems not unlikely, the materies morbi of gout is re-absorbed from the articular structures to act upon the tissue or organ next in order of vulnerability.

Metastatic orchitis as a complication of *mumps* is relatively more common in adults than in children, a fact explained probably by the greater physiological activity of the testicular epithelium in mature life. The specific poison selects first the parotid glands; and secondly, though with much less frequency, and at a later period of the affection, the testicle, for its local development. It is curious that two organs differing so widely in many respects should be attacked by the same agent of disease. It will be remembered that enchondroma has a like proclivity for these glands, and here also there is no obvious explanation of the association.

AUGUSTUS J. PEPPER.

MICROCOCCLUS.—A round or oval micro-organism belonging to the class of SCHIZOMYCETES. The term coccus, applied to spherical organisms, has sometimes the prefix mega (*μεγα*, great) to denote a larger variety (Billroth), so that there are two divisions of the round micro-organisms recognised—viz. megacoccus and micrococcus. These round or oval organisms are found in putrid animal liquids, and in some diseases, as below; for their causal relation to which. See SEPTIC DISEASES, Classification and Etiology of.

As regards their personal life, they grow by fission, so as often to form chains of from two to several hundred, while in rarer cases they are grouped into fours or more, like sarcinæ, and they multiply by simple fission of their protoplasm. Micrococci cannot resist heat like the spore-forming organisms; consequently it is more than probable that no coccus possesses in any degree the property of spores.

Sapric M.—*M. sapricus*.—Micrococci of various sizes are found in almost all dead putrefying tissue. Thus they are found in the necrotic foci of pyæmia, and always in the pus of acute abscesses, and in most decomposing albuminoids.

Pathogenic M.—*M. erysipelatosus*.—A micrococcus is now definitely proved to be intimately connected with the causation of erysipelas. It has been cultivated by Fehleisen, who found the period of incubation in the human being was about twenty-four hours on the average. See ERYSIPELAS.

M. septicus, although not so definitely proved (like that of erysipelas) to be an active carrier of infection, has been found so consistently in pyæmic foci as to deserve a prominent place in this list. It is also found in decomposing wounds, growing on the surface of the granulation-tissue.

M. of acute necrosis and osteomyelitis. In acute necrosis and osteomyelitis this micrococcus has often been observed. When cultivated, it forms beautiful orange masses. Inoculated into animals, it produces ordinary septicæmia, unless a bone has been previously injured, when acute osteomyelitis is set up, with abscesses in the lungs, &c., just as in the acute necrosis of man.

M. endocarditicus.—In ulcerative endocarditis, micrococci are always to be seen in the organisms, on the valves, and in the infarcts in the different organs.

M. bombycis, a large coccus organism which causes death by mechanical mycosis, &c.

M. gonorrhœæ.—The micrococcus known for some time to be present in gonorrhœa has been cultivated, and, by inoculation of the growth obtained, been shown to probably produce the disease.

M. variolæ, the organism of small-pox, is, so far as is known, the probable cause of the pustules in their early stages.

M. vacciniæ, a micrococcus found in healthy vaccine lymph, is credited with being the cause of vaccinia.

M. puerperalis.—In puerperal fever a micrococcus has been discovered in the foci of disease, exactly like the organism of pyæmia.

M. nephriticus.—In suppurative interstitial nephritis, secondary to septic disease of the lower urinary tract. Micrococci are found in the tubules of the kidney, and are supposed to have gained access to that organ by growing in the stagnant residual urine and mucus in the bladder and ureter.

VICTOR HORSLEY.

MICTURITION, Disorders of. See INCONTINENCE OF URINE; RETENTION OF URINE; PROSTATE, Diseases of the; PROSTATIC HYPERTROPHY; STRICTURE OF THE URETHRA.

MILIUM.—*Definition*.—A collection of sebum distending a sebaceous gland, but without an external opening.

Symptoms.—Milium consists of a small white swelling under the epidermis, occurring in the same parts, and due to the same causes as COMEDONES. There is, however, no external opening, as the matter is retained in the sebaceous gland, and does not pass into the hair-follicle.

Diagnosis.—Miliun may be mistaken for xanthoma tuberosum and for molluscum contagiosum. An incision into the little tumour will suffice to distinguish it from the former; as, in miliun, the sebaceous matter will be easily forced through the outlet, whereas in xanthoma nothing will escape but a trace of blood, as the tumour is composed of connective tissue, and is therefore solid. Moreover, in xanthoma the appearance is yellower than is the case in miliun. It may be diagnosed from molluscum contagiosum by the central depression characteristic of that disease.

Treatment.—Careful incision into the tumour, removal of its contents, and scraping or scarifying its lining membrane. To prevent miliun forming, care should be taken to wash the skin frequently with soap and hot water. Constitutional remedies must be resorted to whenever there is any functional derangement or general debility.

MALCOLM MORRIS.

MILK-CYST. See GALACTOCELE.

MINER'S ELBOW. See BURSEÆ, Affections of.

MOLE (*Nævus pigmentosus*).—A circumscribed hypertrophy of the skin, with much small-cell infiltration, in the form usually of a papule or tubercle varying in size from a millet-seed to a hazel-nut, but frequently much larger. In some cases the surface of a mole is smooth; in others it is partially concealed by a growth of hair (*nævus pilosus*). The larger and coarser varieties of mole are usually congenital; the smaller are not commonly observed until after the age of infancy and early childhood has passed. Congenital moles, as a rule, grow only in proportion to the growth of the body; the non-congenital usually increase in size for a time and then cease growing. In a small minority of cases, and under quite unknown conditions, a mole becomes the starting-point of melanotic sarcoma, or (very rarely) carcinoma.

Treatment.—With the exception of the considerations involved in the last-mentioned circumstance, which render advisable the removal of any mole that attracts attention by its growth or is in a situation where it may be irritated, treatment is necessary only when, from its situation, as on the face, it causes a deformity which a patient is anxious to be rid of. The treatment of quite small moles is very simple. They are best destroyed by the application of strong nitric acid; care being taken not

to apply the caustic too freely. For the removal of larger moles, say those from the size of a pea to a horse-bean, a smaller scar will probably be left after removal by the knife or a Volkmann's spoon than by caustic; but great caution should be exercised when the disease encroaches on the thin skin in the neighbourhood of the eyelids, on account of the liability to ectropion from the contraction of scar-tissue in this region. In the case of large moles, say from half an inch to an inch or more in length, the surgeon will do best by removing a portion at a time; the result of the operation being taken as a guide to future proceedings. Either the knife or caustic may be used; the former usually causing less scar than the latter. But it is impossible to lay down a strict rule for all cases.

In the case of very large moles—too large to permit the removal of the whole thickness of the skin at once—a good deal can be done by removing with a sharp scalpel or Volkmann's spoon the *surface* of the skin, only a part of the thickness of the corium or true skin being removed, and no part of the subcutaneous tissue being exposed. The wound should then be covered with a piece of gutta-percha tissue as a first dressing, and after a day or two allowed to scab. By these means, partly by the knife and partly by strong nitric acid, the writer was enabled to remove successfully, and without any subsequent contraction of the scar, a large hairy mole which occupied half the forehead.

W. MORRANT BAKER.

MOLLITIES OSSIUM. See OSTEO-MALACIA.

MOLLUSCUM CONTAGIOSUM (*Synon.* Epithelioma molluscum—Virchow; Acne varioliformis—French authors).—*Definition.*—A chronic disease of the skin, characterised by the development of small tumours, rarely exceeding the size of a pea.

Cause.—This is not certainly known; lately it has been attributed to the presence of a vegetable parasite. There has been much discussion as to the contagiousness of the disease. In America and on the Continent, where the disease is much rarer, it is scarcely believed in, but in this country its contagious nature is almost universally accepted, this belief being based upon such clinical facts as the following:—

1. The frequent simultaneous appearance of the disease on the face of an infant and the breast of a nursing mother.

2. Its occurrence on contiguous surfaces—e.g. the insides of the thighs.

8. Its liability to affect more than one pupil in a school or one member of a family, at the same time.

It must be confessed, however, that inoculation experiments are rarely successful; probably warmth and moisture, with continued friction, are the conditions most favourable for its inoculation.

Pathology.—If a small molluscum tumour be examined microscopically, it will be found to consist of cells packed together in lobular masses, bounded and separated by fibrous tissue. The cells composing the lobules may be roughly divided into two kinds—(1) those at the periphery, closely packed, having large oval nuclei, and corresponding in appearance to the normal cells of the rete mucosum; (2) those towards the centre of the lobule, which are large, ovoid, vitreous-looking bodies, closely placed or more loosely arranged in a reticulum, often of a granular aspect. These are the molluscum bodies, concerning the composition and nature of which there is still much controversy. In vertical sections of minute commencing lesions it has been shown that the peripheral cells of the new growth are continuous or closely associated with the Malpighian layer of the skin, or with that inversion of it which constitutes the outer root-sheath of the hair-follicle. The molluscum bodies are, probably, the result of retrograde changes in the cells concerned in the formation of the hair-structure.

Symptoms.—The lesions develop slowly, taking weeks or months to attain the size of a pea, which they rarely exceed; they commonly appear as flattened pinkish-white tumours, possessing on the infant's skin a peculiar greasy, semi-translucent appearance. In every lesion there is distinguishable, from its very commencement, a central pit or depression (umbilication), probably the widened mouth of the hair-follicle from which it started. This central depression, together with the early flat sessile appearance of the lesions, has suggested their likeness to pearl shirt-buttons. As the tumours increase in size, they overhang their bases and so become pedunculated, but, unlike the *molluscum fibrosum* tumour, they rarely become pendulous. Two or more tumours are liable to coalesce and merge into one larger tumour, which in this case presents more than one orifice. Large tumours are apt to inflame and suppurate, but this may happen to any tumour that is irritated by friction, &c. On squeezing the tumours, a thick, gruel-like fluid can be made to exude from the orifice; sometimes the fluid is thin and milk-like,

and issues in a jet on pressure. If the orifice of a tumour be slightly enlarged with the point of a lancet, and firm pressure be made on either side of its base, there can be forced out or enucleated a pinkish mass which to the naked eye has a minutely lobular appearance not unlike gland-tissue. The tumours are generally few in number and occur in young subjects, but isolated cases are on record in which hundreds of tumours have been present on adults. No pain or itching is complained of.

Diagnosis.—A well-marked example of the disease is not liable to be mistaken for any other affection. Sometimes difficulty arises when attention is drawn to a single suppurating tumour, the special appearances being masked by the inflammation; the probable existence of other molluscum lesions, perhaps so minute that they have at first escaped notice, will help the diagnosis.

Treatment.—Only local treatment is of use. The tumours may be removed by enlarging their orifices and enucleating their contents. If there is much trouble in completely freeing the capsule, the contents may be removed with a small Volkmann's spoon; the large tumours will probably require such treatment. The base of the capsule may be touched with nitrate of silver, to prevent bleeding. The lesions rarely recur.

ALFRED SANGSTER.

MOLLUSCUM FIBROSUM.—*Definition.*—Soft tumours of the skin, due to hyperplasia of the subcutaneous tissue and deep layer of the corium.

Etiology.—The only known cause is congenital predisposition. The tumours occur in both fair and dark races in both sexes, and are seen at all ages, though they nearly always begin in early childhood, and some in the first few months of life, being probably often congenital, but too small to attract notice. The dermatolytic tumours may, however, be acquired in later life, and there are also tumours, of a very similar character to those of childhood, which develop in elderly people, especially between the shoulders and on the face, but they are never numerous. In a considerable proportion of those in whom the tumours commence in early childhood, it has been noted that they have been stunted in both their mental and physical development.

Pathology.—Nothing is certainly known of the pathology of these tumours, beyond the fact of their being immediately due to a hyperplasia of the connective tissue of

either the deep part of the corium or subcutaneous tissue, or both, while some tumours seem to take their origin from the connective tissue round the hair-follicles. In the diffuse or dermatolytic cases, the presumption is in favour of this hyperplasia being due to an obstruction to the lymph-flow in the superficial lymphatics, but we are entirely ignorant of the way in which it is produced. This theory and many points in its anatomy bring this disease into pathological relationship with elephantiasis Arabum, though the clinical differences are obvious.

Anatomy.—On section of a medium-sized tumour it is found to consist of more or less perfect fibrous tissue, from which a small quantity of clear yellow fluid can be expressed. The fibrous tissue is coarsest and best developed at the base, while in the centre it is loose and gelatinous, and at the periphery fine and delicate. The degree of development of the fibrous tissue is in proportion to the age and size of the tumour; so that in a large tumour there will be very little gelatinous tissue, while a smaller one may consist entirely of it. In all, the papillary layer of the corium and the epidermis are unchanged. Cells with large nuclei are scattered singly, in foci, or in strata between the layers of connective tissue, and are most abundant in the young, and sparse in the old, tumours. The vascular supply is derived from large vessels, which enter at the base and are distributed in fine capillaries at the periphery.

Varieties.—There are the following varieties:—1. Multiple, small, soft tumours, in which the surface of the skin is normal. 2. Dermatolytic tumours, with small tumours like the first variety. 3. Dermatolytic tumours without other tumours.

Variety 1.—The tumours are roundish and soft for the most part, though they may be firm in places, and when pinched up, the contents can be rolled between the fingers. The skin over them is either tense or lax, smooth and of normal colour, except sometimes from vascularity, and it is not uncommon to find the plugged orifice of a sebaceous gland in the centre of a small tumour. The tumours vary in size from a pin's head to a hen's egg, though the majority are not larger than a walnut; some are sessile or even deep in the skin, others pedunculated. They come most frequently and abundantly on the trunk, next on the occiput and the rest of the head, face, and limbs; but they are rare on the palms and soles, where, if pre-

sent, they get flattened by pressure. Occasionally the mucous membranes become involved, especially the lips, gums, and hard palate. The tumours gradually increase in number and size, but do not tend to shorten life, and are only inconvenient from their size, position, and numbers, and, though sometimes few, are often present in hundreds, and even thousands. Occasionally, when the growth is unusually rapid, they get tense and red, excoriate, or even ulcerate, and slough off from the vessels being stretched and occluded.

Variety 2.—In the dermatolytic cases, besides the tumours already described, there are others much larger, often weighing many pounds; they have a broad attachment, consisting of lax pendulous masses, which may be in folds like a coachman's cape, and feel like masses of skin and fat. These tumours spring most frequently from the occipital region, the side of the neck, flanks, buttocks, thighs, and sometimes from some parts of the face. They may reach to an enormous size, and, when they occur without the small tumours, constitute Variety 3, which is placed separately, because, whilst the other varieties begin in early childhood, these may be acquired. The tumours are often even more diffuse than in the last kind, and, in a case under the care of the writer, the enormous pendulous folds depended like flounces from the buttocks and thighs, in consequence of prolonged suppuration in the buttocks produced by a fall. In a few rare congenital cases, the skin has been very lax when pulled out, but without any hyperplasia, and retracted to the normal degree when the traction ceased; but this is evidently a different condition altogether.

Diagnosis.—When there are multiple soft, sessile, or pedunculated, roundish tumours with the skin over them normal, there can scarcely be any difficulty in the diagnosis. Multiple fatty tumours are most like them, but they are flatter, lobulated, and do not project globosely above the surface, in the way some of the molluscum tumours are sure to do. When the tumours are single or few, the diagnosis from soft moles would be made by the fact of the moles having been congenital, and not having grown materially from birth. They may resemble sebaceous cysts, but though a large comedo is common in the molluscum tumour, on pressure nothing but the comedo can be expressed, while nearly or quite the whole of the contents can be squeezed out from the sebaceous cyst.

Prognosis.—The tumours tend to increase in number and size, and although occasionally the contents of a small one may be absorbed, it makes no practical difference to the disease as a whole. They may be inconvenient, but are never dangerous to life.

Treatment.—Where any one tumour is inconveniently placed, or where there are only a few, if pedunculated they may be removed by ligature, the galvanic cautery or écraseur, and if sessile excised. Large dermatolytic tumours have also been successfully removed in several instances, but the removal must be complete, partial excision having been followed by regrowth.

H. RADCLIFFE CROCKER.

MORPHŒA. See **SCLERODERMA**.

MORTIFICATION. See **GANGRENE**.

MOUTH. See **PALATE**, Affections of the; **RANULA**; **STOMATITIS**.

MOVABLE KIDNEY is a condition in which the organ has lost its usual attachments in the perinephral fat, and glides about a varying area attached only by its vessels and ureter. In some cases, it slips about behind the anterior peritoneal covering; in others, it has gradually come forward until it has drawn out for itself a sac of serous membrane, covering both its surfaces, and gathered in round the vessels of the hilus so as to form a mesonephron. For the latter condition, said to be congenital as a rule, the term 'floating kidney' has been suggested, to distinguish it from the commoner 'movable kidney.' Both conditions are not so infrequent as is supposed. Thus, out of 5,500 patients, examined in a German hospital specially on this point, about 1 in 250 had movable kidney. Among women it is found much more frequently than among men, and this fact, perhaps, furnishes us with a clue to its causation; the latter, however, still seems somewhat obscure. But it is significantly frequent between the ages of twenty-five and forty in females, and this being the most active child-bearing period, it seems not improbable that the changes taking place during gestation in the abdomen, and more particularly after parturition, when the parietes and internal organs are relieved from a great strain, may play an important part in the displacement of the organ. Tight-lacing is also supposed to explain its greater frequency among women. This may also be one of the causes why it is more frequent on the right side than on the left, for on the right it is less protected

against the constriction of the girdle or stays than on the left, where it is more or less covered by the stomach and spleen. But, in many cases, the occurrence of movable kidney can be traced to some violence, such as a fall or blow upon the side; or to hard riding, which, having once shaken the kidney loose from its attachments, has never permitted it to recover itself again.

The *symptoms* are usually not very marked—indeed, the condition is often discovered accidentally where none have ever been present. But, in some cases, there can be no doubt that very severe suffering is caused by the movements of the organ, and, most probably, by the drag upon the pedicle. Among the symptoms in severe cases may be mentioned dragging, sickening pain in the loins, with nausea and, occasionally, vomiting, diarrhoea or constipation, and frequency of micturition; other less definite sensations are often complained of, such as depression of spirits and general weakness.

The *diagnosis* of the condition is based upon the above symptoms, and on the presence of a movable tumour, of the size of the kidney, somewhere between the normal position of the latter, the umbilicus, and the anterior superior spine of the ilium. This tumour is freely movable in an upward direction or laterally, but not downwards, as the patient stands. It can be easily thrust upwards above the ribs into the normal position of the kidney. If grasped or pressed upon, a dull, sickening pain is complained of.

Treatment is not always called for in these cases. If there be much suffering, however, several means have been found of relieving it. In the first place, rest in the recumbent position is usually temporarily useful, then firm bandaging of the abdomen with a pad placed over the replaced kidney; next, attention to the bowels, and the use of tonics and cold douches, &c.; lastly, stitching the offending organ to the abdominal walls has been tried with benefit. See **NEPHRORAPHY**. Finally, removal of the offending organ has been resorted to in several severe cases, but so far has not been considered a justifiable procedure in this country. In all cases where there is suffering, violent exercise is to be avoided. Occasionally the symptoms are severe and give rise to suspicion of inflammation in the kidney, in which case leeches and hot baths and fomentations should be employed, with the internal use of opium and diaphoretics.

The *prognosis*, in cases where the movements of the organ give decided trouble, is not very favourable as regards the prospect of permanent relief without operation. Once having broken loose from its attachments, the kidney is very unlikely to become fixed again spontaneously. Fortunately, in many cases, the condition causes but little suffering, and is amenable to treatment by rest and palliatives.

A. E. BARKER.

MOXA. See ISSUES.

MUCOUS PATCHES.—The mucous patch, known also as mucous tubercle and mucous plaque, is a very frequent lesion of acquired secondary, and of inherited syphilis, and, in an exaggerated form, has been met with occasionally in tertiary syphilis. As a manifestation of secondary syphilis it occurs early, and is associated with the papular eruption. It is met with usually in a multiple form, and is situated either on mucous membrane, or on thin and moist skin subject to friction or the frequent contact of irritating secretions or foreign material. The favourite situations of crops of mucous patches are the vulva in women, the skin about the anus both in men and women, and the scrotum and scroto-crural fold in men; but especially on the tonsils, on the tongue, and at the labial commissures. The lesion, when developed on a cutaneous surface, presents an oval elevation of a whitish-grey or pink colour, dry on the surface, and surrounded by a zone of red and inflamed skin, from which there is a continuous discharge of thin and very fetid serous fluid. When situated on the mucous membrane of the tonsil and tongue the patch has a smoother surface, is more defined at its margin, is less elevated, and causes less local irritation. When mucous patches, on a cutaneous surface in constant contact with another surface, are frequently irritated by the friction of clothes or by discharges, the patient usually suffers much from itching and sometimes smarting pain; but the lesion, when affecting a mucous surface, causes as a rule but little trouble, and is frequently unnoticed. The mucous patch is often associated with some fissuring and ulceration of the adjacent parts, especially when it occurs at the labial commissures, and when met with in congenital syphilis; and also as the manifestation of advanced syphilis described by Fournier as the 'tertiary syphilitic plaque.'

In dealing with cases of mucous patches, particularly when occurring in infants, it is

very necessary for the surgeon to bear in mind the well-established fact that the discharge from the surface of this lesion is highly contagious.

The *local treatment* of mucous patches, when situated on a cutaneous surface, should consist in attention to cleanliness of the affected region, in one or two applications of solid nitrate of silver or sulphate of copper, and frequent dusting with calomel powder. When situated on a mucous surface, especially in the mouth, the local application of a ten-grain solution of chromic acid (Butlin) will be almost universally attended with a good result.

W. JOHNSON SMITH.

MUSCÆ VOLITANTES. See VITREOUS, Diseases of the.

MUSCLES, Affections of.—**CONTUSION.** Muscles are liable, like other textures of the body, to suffer from contusions or bruises.

Causes.—The principal are blows and kicks, the impact of spent balls in warfare, and splinters from objects struck or blasted; also falling against a firm obstacle, or the fall of some object on the person.

Pathology.—A bruise implies more or less injury to texture, and may vary from a very slight injury, causing pain and stiffness for a few days, to one which may reduce the muscle to pulp and compromise its vitality. In even the simpler cases, however, there is more or less tearing of the fibres, or of their ensheathing sarcolemma, or of the nerves or blood-vessels. This explains the extravasation of blood, and loss of function in the muscle, which generally follow injury, in varying degree. Bruise of muscle is common, though not so much so as one might suppose from the vast extent of muscular covering with which the body is invested. The muscles more liable to suffer are the deltoid, gluteus maximus, those of the lower limb generally, and of the abdomen.

Symptoms.—Pain is of a dull character. There is inability to use the muscle, with increase of pain when the attempt is made. Swelling is present, due to extravasation of blood and effusion of serum. The swelling is deep-seated; that is to say, under the fascia. Ecchymosis may be evident at once, from injury to the superimposed skin. But discoloration from the bruise of the muscle will not appear for some time (days probably), and will then be at some dependent part, from gravitation of the blood. The symptoms which present themselves later are—atrophy from injury to nervous or vascular supply, or both; loss of power from

injury to the fibres or the motor nerves; contraction from the parts being held in a position of relaxation to relieve pain; lastly, inflammation and even abscess may succeed a bruise of muscle.

Diagnosis.—The only difficulty is in cases where the muscle injured lies over a joint, such as the shoulder. The primary swelling and subsequent (occasional) flattening from atrophy and loss of power in the arm, may be supposed to be due to dislocation. Careful examination should, however, enable the surgeon to make out that there is neither dislocation nor fracture in any given case, and thus certainty is reached by a process of exclusion. *See* DISLOCATIONS; FRACTURES; also SHOULDER; HIP, &c.

Treatment.—1. Rest of the muscle and relaxation of it, if possible; 2. Prevention of effusion of blood; 3. Restoration of function to muscle; 4. Prevention of evil results, such as inflammation, contraction, atrophy, &c. The first two indications are best carried out by attention to position and support with a bandage evenly applied over cotton wadding, or by cold, or by anodyne or astringent lotions. Cold may be easily applied by pounded ice in a waterproof bag of any kind, by irrigation, maintained by placing a few threads of worsted hanging from a vessel filled with cold water, or by evaporating lotions. A convenient formula for the latter is *R. Ammon. hydrochlor. ʒj.; Pot. nitratis ʒj.; Aquæ fʒvj. or viij., to which is sometimes added Sp. vini rect. fʒj.* For astringent lotions hazeline, tincture of arnica (1 to 7 of water), or lead and opium (gr. viij. of each to the fʒj.) may be used.

The third and fourth indications should be carried out by early movements, to prevent stiffness and contraction, and the combination of rubbing, kneading, and movement termed 'massage' (*see* MASSAGE). Weakness of the muscle and some pain in using it will continue for a time. Gentle support will often relieve this, along with the douche of hot water at night and cold in the morning. The application of the galvanic current will be necessary should atrophy or paralysis threaten.

In applying electricity to muscle the following rules should be followed:—

If there is simple atrophy without paralysis, this is probably due to want of use, and the Faradic current should be employed to make the muscle contract. If atrophy continue, there may have been some injury to the trophic nerves, in which case the constant current (with massage) may be useful. If the muscle do not answer to the stimulus,

then there has been injury to the motor nerve, in which case the constant current should be employed (occasionally reversing and interrupting it) until some reaction is produced, when the Faradic current should be used. In cases of atrophy and of paralysis the maintenance of the temperature of the part is important, and materially assists recovery.

Acupuncture is sometimes of great service in relieving the painful condition of muscles left after an injury, an ordinary darning-needle being plunged a few times into the substance of the affected muscle with immediate benefit.

STRAIN OF A MUSCLE implies something more than mere stretching—a certain amount of texture gives way. This injury is therefore strictly speaking a minor degree of rupture, and may be considered along with the following affection.

RUPTURE OF MUSCLE is caused by a pulling strain in the long axis of the muscle, contraction of the muscle itself, or both of these together. Separation of muscular fibres from wound or blow may also occur, but this will be considered under other heads. There are certain causes which predispose to muscular rupture, such as contraction, atrophy, and degeneration. Rupture of muscle may occur in tetanus.

Symptoms and Diagnosis.—The patient feels a sudden pain as if the part had been struck. There is weakness or perhaps inability to use the muscle. These symptoms occur when there has been a sudden or forcible flexion or extension of a joint, powerful muscular resistance to some force, or a sudden effort made, as when a person tries to recover himself after slipping. If the muscle injured be in the lower extremity the patient may fall. On examining the part, if the rupture has been extensive, a gap in the muscle is felt, which is more marked when the muscle is in a state of contraction, in which condition there is added a swelling above (on the proximal side of) the gap or hollow. There is subsequent swelling from effusion of blood and serum, which masks the depression; but the gap in the muscle appears again after absorption of the effusion and disappearance of the swelling. Later on there remain only loss of power and atrophy of the muscle, which are in proportion to the amount of injury. Diagnosis should be easy if the foregoing symptoms are well-marked. When these are slight then the case may be considered one of slight rupture or strain.

Treatment.—Rest and relaxation of the muscle, to favour approximation of the torn

fibres. In severe cases, where great weakening or entire loss of power in an important muscle might result, it will be necessary to cut down at the part, and sew together the torn ends with catgut, with strict antiseptic precautions. The resulting uniting medium is connective tissue (at first at any rate); after a time the muscle recovers its power entirely. After the rupture has firmly united, use of the part must be commenced, to prevent contraction, atrophy, &c. If movement is begun or permitted too soon, tearing of the uniting medium may take place, or an abscess may form from the irritation.

WOUNDS OF MUSCLE.—These may be divided into *subcutaneous* and *open*, and into *transverse* and *longitudinal*. Subcutaneous wounds are generally inflicted by the surgeon for the treatment of some deformity. Open wounds may be treated as ordinary wounds of the soft parts (*see* WOUNDS). Should the muscle be cut longitudinally, there will be a tendency for the cut edges to close together and so interfere with drainage; should it be severed transversely, there will be a tendency to gape. In the latter instance stitches should be inserted into the muscle itself, and union of the cut surfaces sought for, as already described in the treatment of *rupture* of muscle.

HERNIA OF MUSCLE may occur where there is a gap in the investing fascia. The displaced muscle may be replaced and retained in position by pressure, as by a bandage. Should reduction or retention be impossible, the part may be cut down upon, the opening in the fascia enlarged and then stitched up after the muscle is returned. Such an operation should of course be performed only under strict antiseptic precautions.

CONTRACTION OF MUSCLE.—This condition may occur from malposition of parts (as in torticollis), but usually is in connection with disease (as of the joints). It may also occur after an injury, as in contraction of the quadriceps in cases of fracture of the patella. If gradual extension and use of the parts is not sufficient to restore function and symmetry, tenotomy (section of the tendon), or myotomy (section of the muscle), may be necessary. The latter operation only need be referred to here. It should be performed *subcutaneously*, and in one of two ways—either by cutting across the muscle completely, and keeping the parts separate till union has taken place at a sufficient length to atone for the previous contraction, or by making a number of V-shaped incisions in the substance of

the muscle, as recommended by Dr. Macewen of Glasgow.

Spasmodic contraction of muscle is due to some nervous affection, and should be treated by tenotomy, myotomy, neurotomy, or nerve-stretching, if internal remedies are not sufficient. *See* TORTICOLLIS, &c.

DISEASES OF MUSCLE.—*Myalgia*, or pain in muscle, may be due to injury, nerve-pressure, inflammation, rheumatism, certain febrile conditions, certain poisons, or neuralgia. The treatment will be to get rid of the cause, and locally to apply anodynes or counter-irritants.

Inflammation of muscle, or Myositis, may result from injuries (as bruise or strain), from hypodermic injections (dirty needles), from rheumatism, or from a poison, such as syphilis or septicæmia.

Symptoms and Diagnosis.—There are the ordinary signs of pain, heat, redness, swelling, and interference with function. It will be possible to locate these in the muscle or muscles affected. Should supuration occur, there will be throbbing, rigors, &c. Myositis is a very painful affection, and pain is much increased on movement. In the rheumatic variety, pressure and rubbing sometimes relieve pain.

Treatment.—Rest, application of cold in the early and acute stage, hot fomentations or poultices when the symptoms are fairly established, and anodyne lotions, of which belladonna with glycerine is one of the best. An abscess should be opened early and with antiseptic precautions, as otherwise it is apt to burrow. If the abscess is deep-seated, the skin and fasciæ only should be cut with a knife, and then a director be thrust through the muscular substance in the direction of the abscess. In this way, excessive bleeding is avoided. If opening is delayed, sloughing of fascia is apt to follow.

Sequelæ.—Organisation of plastic effusion may give rise to fibrous bands, which necessarily interfere with the function of the muscle. An abscess becoming absorbed may give rise to a caseous concretion. Contraction of a muscle may remain for some time after inflammation, to be treated by extension, friction, and use of the parts.

MUSCULAR RHEUMATISM.—The commonest examples are lumbago and pleurodynia, the causes being strains, colds, gonorrhœa, syphilis, and rheumatism. It is supposed to be a subacute inflammatory affection, and is very apt to recur. Treatment: counter-irritation and anti-rheumatic remedies. The writer has found in certain

persons, in whom pleurodynia or lumbago are apt to occur from exposure to cold, that tincture of *Actea racemosa*, in thirty or forty drop doses, repeated every four or six hours, is sometimes beneficial.

SYPHILIS IN MUSCLES.—Syphilis may give rise to myositis, myalgia, contraction, and gummatus infiltration. *See SYPHILIS; GUMMA.*

When gummata occur in muscle, it is generally in the form of hard masses, which give a beaded appearance to the muscle. They tend to soften and break down. They are not very painful, and do not interfere much with the use of the part. They disappear under treatment with potassium iodide and counter-irritation. If left to themselves they tend to suppurate.

HYPERTROPHY OF MUSCLE.—This may be true and simple, from use and increase of vascular supply, or false and due to fatty deposit, or to the so-called pseudo-hypertrophic condition. The tongue is prone to suffer from a hypertrophic condition termed macroglossia, caused by attacks of glossitis, due to lymphoid infiltration, and frequently requiring removal of a portion of the organ. *See MACROGLOSSIA.*

ATROPHY OF MUSCLE.—(1) Simple atrophy may occur from a variety of causes, such as injury, want of use, pressure, injury to a nerve or blood-vessel, ankylosis of a joint, disease of a joint, and lead-poisoning. Treatment must be according to cause, with the use of galvanism, blisters, passive motion, friction, massage, &c.

(2) Atrophy may also occur as a symptom of disease of the nervous system, as in infantile paralysis, progressive muscular atrophy and pseudo-hypertrophic paralysis, which, being medical affections, will not be considered here.

Paralysis in children frequently causes deformities which require, for their treatment, operations. *See CLUB-FOOT; LATERAL SPINAL CURVATURE.* The treatment of atrophy after injury is referred to under Bruise of Muscle.

Degenerations of Muscle.—Fatty degeneration may be due to want of use, improper diet, alcoholic indulgence, or disease. Treatment will be exercise, a properly regulated diet, &c.

Waxy degeneration is found in connection with some fevers, granular after myositis or associated with fatty degeneration. Pigmentary degeneration may be associated with atrophy or the wasting of old age. Calcareous degeneration has been observed in connection with a similar condition of other organs.

OSSIFICATION OF MUSCLE.—This differs from calcareous degeneration in the fact that there is a formation of true bone. The stony hardness of the deposit, along with the interference with the function of the muscle, should make diagnosis comparatively easy. In regard to treatment there is little to say. Blisters are said to relieve pain and check the morbid process.

TRICHINOSIS, affecting the muscles, occurs not infrequently in this country, but is much more common abroad. The disease is shown by the presence in the muscles of numerous whitish specks, each of which, under the microscope, is seen to contain a small worm coiled up in a spiral form. The ingestion of raw or imperfectly cooked flesh, especially that of the pig, as in hams and sausages, is the only known source by which the trichinae find access to the body. Within a few days after the worms are swallowed, they produce eggs, and the embryos when hatched speedily find their way to the muscles, either directly or through the vascular system.

Symptoms.—The patient complains, first, of loss of appetite and prostration, the face also swells; the muscles next become painful, swollen, and contracted; cedema then supervenes. This disease has been mistaken for acute rheumatism, but the absence of joint-implication should be a sufficient guide. No treatment is of any avail.

TUMOURS OF MUSCLE.—These are fibroma, lipoma, enchondroma, osteoma, angioma, cystoma, myxoma, sarcoma, and carcinoma. A. G. MILLER.

MUSCULO-SPIRAL PARALYSIS (Crutch Paralysis, Chair-back Palsy, Drop-wrist).—**Symptoms.**—Loss of power over the supinators of the forearm and extensors of the wrist and hand, in consequence of which the forearm assumes the position of complete pronation; the hand drops loosely forwards on the wrist, the fingers are flexed into the palm and lie over the thumb, which is adducted. Attempts at extension of the hand are followed by some flexion of the first phalanges and extension of the second and third, due to the action of the lumbricales and interossei. A slight amount of supination can be effected with some effort by the biceps, when the forearm is semi-flexed. Extension of the forearm upon the arm will be more or less affected; the higher the nerve-lesion the more complete will the loss of this extension-power be. The onset of the disease may be sudden

or gradual; cases in which it is gradual usually commence with weakness about the hand and wrist, the supinators are then affected, and finally the triceps. There will be loss of sensation over the cutaneous parts supplied by the nerve.

Causes of Sudden Paralysis.—Sharp blows on the musculo-spiral nerve as it winds round the humerus; the palsy from such a cause is usually transient. Division or laceration (1) in direct wounds, (2) by ends of fragments of a fractured humerus, or (3) during removal of sequestra in operations for dead bone; pressure on the nerve by a sharp edge (e.g. back of a chair); laceration of the brachial plexus; cerebral lesion.

Causes of Gradual Paralysis.—Degeneration of nerve after injury; implication of nerve in callus about a fracture of the middle of the humerus; pressure from a crutch; lead-poisoning; syphilis.

Treatment.—In division of the nerve in an open wound, its divided ends should be found and united by suture; the same course should be pursued, if possible, when the nerve is divided in operations for extracting sequestra. In division from simple fracture, the bone may be allowed to unite and then, if the palsy continues, the nerve-ends should be dissected out and brought together with suture. When implicated in callus, the nerve should be cut down upon and freed from the pressure. *See NERVES, Injuries of.*

In crutch and chair-back palsy the recovery is usually spontaneous the cause having been removed, but may be assisted by electricity, 'massage,' and muscle exercise, treatment which may also be useful in the degenerative form. In cases dependent upon lead-poisoning or syphilis, iodide of potassium in 5 to 10 grain doses will usually effect the cure, aided, if necessary, by the mechanical treatment just mentioned.

WILLIAM H. BENNETT.

MYALGIA.—Pain in Muscles.

MYCETOMA.—The Fungous Foot of India. *See FUNGUS DISEASE OF INDIA.*

MYCOSIS INTESTINALIS. *See MALIGNANT PUSTULE.*

MYDRIASIS.—Dilatation of the Pupil. *See IRIS, Diseases of the.*

MYELOID SARCOMA. *See SARCOMA.*

MYOMA.—Muscular-tissue tumours would be held to be rare, but for the presence of this element in growths whose structure

in the main is composed of other tissues, as the myo-fibromata of the uterus and the myo-adenomata of the prostate. With these composite tumours excepted from the list, comparatively few instances of pure myoma have been described, and they, for the most part, have been found either in the immediate area of the kidneys of very young children or in the walls of the alimentary canal, the gullet perhaps most usually. In speaking of myomata, these are regarded as the true type of muscle-tumours, although the term myoma, when introduced, was intended to distinguish tumours, apparently fibrous but in which flat muscular fibres occur abundantly, from the ordinary fibrous tumours formed solely of connective tissue.

Cause.—The myomata which occur in infants are almost certainly congenital; hence their cause is to be found probably in errors of development. For the myo-fibromata of the uterus, which are the commonest form of these growths, it is sufficient to point out that the two elements of muscle and fibrous tissue mainly constitute the organ, and that during the menstrual period of life the uterus is once a month the seat of active hyperæmia. That this periodic turgescence of the organ is the cause of these tumours, seems evident from the shrivelling which often follows, and may be expected to follow upon, the menopause. Lastly, these tumours seem to be hereditary in the female members of some families.

Pathology.—As has been said already, myomata connected with the kidney form some of the best examples of muscular-tissue tumours. They are usually of firm consistency, yellowish-white in colour and irregular outline; on section, bands of interlacing fibres are seen; under the microscope the fasciculi are seen to be composed of muscular fibres, whilst nodules of fibrous tissue are commonly interspersed.

Symptoms and Diagnosis.—As before removal it would be impossible to distinguish these tumours from fibromata, all that can be said is that they are firm and nodulated, sometimes doubtfully fluctuating. Should, however, a suspicion exist of a tumour being a myoma, the fact could of course, as a matter of interest, be ascertained by teasing out a fragment and microscopically examining its structure.

Treatment.—There are no special circumstances attaching to the treatment of myomata. Whether to perform an operation for their removal or to leave them alone has to be determined upon the general principles of dealing with solid tumours.

ALFRED WILLETT.

MYOPIA.—Short-sight. *See* REFRACTION, Errors of.

MYOSIS.—Contraction of the Pupil. *See* VISION, Disorders of, from injuries of the Head and Spine.

MYOSITIS.—Inflammation of Muscle. *See* MUSCLES, Affections of.

MYOTOMY. *See* MUSCLES, Affections of.

MYXŒDEMA. *See* THYROID GLAND, Diseases of the.

MYXOMA.—A new-growth of the connective tissue type, the essential feature of which is a gelatinous material, termed 'mucous tissue.' Tumours of this nature may be quite *simple*, as in nasal mucous polypus; or *complex*, as in myxo-adenoma, myxo-chondroma, or myxo-lipoma. These latter tumours, as a rule, grow either in the salivary and mammary glands or in the areolar subcutaneous tissue; but they are rare, and are of more interest to the pathologist than to the practical surgeon.

Pathology.—Myxoma is usually an affection of the adult period of life. In some complex tumours the myxomatous elements even appear to have been superadded to the original growth, possibly as a degene-

ration of its tissue. Microscopically, a myxoma resembles embryonic fat. It is composed of scattered cells, usually stellate in shape, with very fine connecting fibres widely separated from each other, whilst in the interspaces a fluid like mucus is contained. This fluid exudes freely from the cut surface, and possesses the specific characters of mucus.

Symptoms and Diagnosis.—Myxomata, other than nasal polypi, can scarcely be said to possess such definite features as to enable one to distinguish them from other tumours, whose consistency seems doubtful and suggestive of partial fluidity of contents. An aspiration and examination of the mucoid fluid extracted might enable a diagnosis to be made before operating. After removal, a myxoma may be diagnosed from a colloid growth, which it most resembles, by the fact that the colloid material is for the most part contained within cysts; but still more by the different microscopic characters of their respective cells and by reactions to chemical tests for mucin.

Treatment.—There is nothing in the nature of a myxoma to contraindicate the removal of any tumour thought to be of this character. ALFRED WILLETT.

N

NÆVUS, literally a spot or mole on the body.—This disease is, according to the classification of tumours at the present day, placed among the angiomas or vascular tumours. It is popularly known as mother's-mark or strawberry or raspberry tumour, but it has received almost numberless professional synonyms in various countries.

Causes.—Nævus is generally regarded as a congenital affection, and yet it often first shows itself a month or six weeks after birth. It is popularly supposed to be due to some impression made upon the mind of the mother during pregnancy.

Varieties.—It will be most satisfactory to consider nævi from a clinical point of view, and to divide them into three classes.—(1) those in which the skin is principally involved—the cutaneous; (2) those in which the subcutaneous tissues are principally implicated—the subcutaneous; and (3) those in which the skin and subcu-

taneous structures are simultaneously involved.

Situations.—Nævi are generally supposed to be met with most frequently on the head and face, and no doubt these are common situations; but this conclusion may be fallacious, inasmuch as, being more exposed to view, they are apt to attract more than ordinary attention. It is alleged that they are more commonly met with in girls than in boys, and they do not seem to interfere with the general health. Nævi occur in all parts of the body, not only on the skin, but also on mucous surfaces, as the conjunctiva, extending even to the retina. They are found in the mouth, inside the cheek, on the hard palate and gums, on the tongue, fauces, and pharynx, and in the cavities of the nose and ear; and, further, the vascular structure has been noticed within as well as without the skull, the capillaries of the dura mater and scalp being simultaneously involved.

These vascular growths are also not uncommonly met with on the pudenda, and one case is recorded of nævus of the scrotum.

Symptoms and Diagnosis.—With regard to the *cutaneous* variety, there is usually no difficulty in arriving at a correct diagnosis. The nævus presents itself as a crimson spot of variable shape and size. It is generally circular, not uncommonly having an irregular, leaf-like edge. In some cases it is smooth on the surface; in others it has a granular appearance not unlike the surface of a raspberry, hence its popular title, raspberry-mark. Its progress is comparatively slow, owing to the resisting nature of the skin. It may or may not be raised above the level of the skin, and it often has at its circumference a scarlet appearance whilst the centre presents a cicatricial aspect, having a white glistening surface with small vessels meandering in all directions. Pressure with the finger causes the colour to fade or almost disappear, but the instant the pressure is relaxed the growth re-assumes its vivid hue. There is, as a rule, no marked pulsation in this variety, but the tumour may become excessively turgid when the child cries. There is a great disposition in this variety for the nævus to remain stationary, and ultimately to disappear altogether without operative interference.

The diagnosis of the *subcutaneous* variety is not always so easy, and the difficulty depends to some extent upon its depth from the cutaneous surface, as well as upon the thickness of the integument covering it. Surgeons of repute have committed and acknowledged errors in diagnosing these cases: thus an instance is recorded in which a child had a small tumour situated at the inner angle of the right orbit, presenting apparently all the characters of a subcutaneous nævus. Threads were passed through the tumour with the view of effecting a cure. Cerebral symptoms came on soon after the operation, and the child died. At the post-mortem, an encephalocele was found passing through the suture between the ethmoid and frontal bones. Again, an operation was undertaken with the view of removing a supposed atheromatous tumour of the cheek. The growth turned out to be a vascular tumour, and as the hæmorrhage was smart it was removed by ligature. Erectile tumours have also been mistaken for enlarged glands, and a meningocoele at the anterior fontanelle for nævus.

The subcutaneous nævus has generally the following characters:—The skin is thinned and transparent, and through it may be discerned a bluish patch of variable hue, having an oval or globular outline with or without definite limits. Sometimes, probably arising from position or from extreme thickness of the skin, no change of colour is noticeable, and the patient is brought to the surgeon because there is a slight fulness or swelling of the part, which, if it be on the face, occasions a slight or well-marked deformity. The size of course, varies, but on manipulation the growth has a doughy, soft, boggy feel, not unlike a bag of earthworms or even a piece of fat. Sometimes it has a granular or shotlike feel to the touch. Slight pressure diminishes the size of the tumour, but the growth refills steadily and surely as the pressure is withdrawn. There is little, if any, decided pulsation, and if present it is of a slow, indolent character.

The *mixed* form of nævus partakes, as may be supposed, of the characters of the two varieties just described. The skin itself is often disproportionately affected; there is frequently only a small crimson patch involving the skin, whilst the subcutaneous structures are implicated to a far greater extent than might at first sight be supposed; thus, in one instance the superficial redness was scarcely the size of a threepenny-piece, whereas the deep swelling was fully four inches in diameter.

Pathology and Progress.—Pathologically, a nævus may be described as a tumour consisting of blood-vessels communicating in various degrees, and united more or less by connective tissue, and matted together in a mass in the subcutaneous or some other tissue. Two classes of nævi are described. 1. The simple *angeiomata*, in which the new vessels are exactly like the normal capillaries or arteries and veins. These vessels may be newly formed, but, in many instances, they appear to be the original vessels enlarged to a considerable extent. 2. The cavernous *angeiomata*, in which there is a structure closely resembling the corpus cavernosum of the penis. Here there are a number of alveolar spaces, sometimes much larger than those in true erectile tissue, which are distended with blood supplied by numerous arteries, the fluid circulating feebly through them. Other observers believe that nævi commence in the capillary network of vessels which normally surround the hair-follicles.

Nævi make variable progress: the strictly cutaneous form either remain stationary, or disappear spontaneously without any interference on the part of the surgeon; in the subcutaneous and mixed forms an operation of some kind is generally called for. But these, again, may remain stationary, or they may suppurate and thus get disintegrated; or they may undergo fatty degeneration, when they are known as nævoid lipomata; or they may undergo cystic degeneration, the cysts being filled with a clear, sanguinolent fluid.

Treatment.—There is scarcely any limit to the number of methods that have been devised for the cure of nævus, and perhaps it is well that the surgeon should have a choice, because each case must be judged on its own merits; and the treatment will necessarily vary with the nature of the case, depending upon the situation and character of the morbid growth. The main object is to arrest the growth, so as to leave a non-vascular cicatrix in place of the nævoid tissue. As already stated, surgical interference is not always required; without any assignable reason the vascular spot sometimes disappears spontaneously, or its disappearance seems to be induced by some trifling cause. Such cases are, however, rare, and more frequently the surgeon is compelled to have recourse to operative measures of some kind.

1. *Compression.*—This plan of treatment at first sight seems inviting, but it is obvious that the morbid growth must be so placed as to ensure a firm *point d'appui*. Abernethy treated a severe case of nævus of the arm by applying a many-tailed bandage of sticking-plaster to the part. A roller was applied over the plaster and kept wet, so that (1) equable pressure was obtained, and (2) reduction of temperature effected. The cure, which was, however, only partial, took six months.

It has been alleged that even the pressure of the child's clothes has arrested the growth. Collodion and styptic colloid applied thickly have certainly a marked effect in reducing the size of nævi. An astringent effect may also be produced by a saturated solution of alum, either in rose-water or glycerine. The ether spray has been employed, and also a method of subcutaneous rupture, in which the nævi is rapidly squeezed so as to break up the vessels when full.

2. *External applications* may be used to excite either adhesive or superficial suppurative inflammation. Dieffenbach recommended that pure liquor plumbi should be

applied on lint. After a few days the swelling becomes whiter, flatter, and firmer. A mixture of 1 part of tartarised antimony to 2 parts of emplastrum resinæ has been used, and must be continued until pustulation takes place. Again, corrosive sublimate, 4 parts to 30 parts of collodion, causes rapid desiccation, and the application of liq. arsenicalis, or the tincture of iodine, or the compound iodine ointment, has been followed by good results.

Blisters and croton-oil are occasionally used. The application of nitrate of potash causes a vesicle; the moistened finger is dipped in the powder, and the nævus gently rubbed with it.

Vaccination was at one time a favourite remedy; but even if the nævus be cured, it is uncertain whether the patient is protected against an attack of small-pox. If employed it should be done efficiently. Nélaton's plan was to take the finest insect needles, and charge the points with virus direct from the child's arm. Having passed a needle in, it was left *in situ* for a few instants until the tissues had time to become impregnated with the virus. Some surgeons make a point of applying the vaccine lymph at the circumference of the growth. It has been further suggested to inoculate the nævus with pus. The process of tattooing has been employed, using white lead or oxide of zinc, or calcined magnesia, with a sufficient quantity of vermilion or other colouring substance.

The potassa caustica also has its advocates; or the potassa cum calce (Vienna paste) may be used. The paste is spread on the part, and is allowed to remain for ten or fifteen minutes, whilst the skin around is protected by adhesive plaster. Strong nitric acid is a very efficacious remedy, and answers exceedingly well if carefully applied to the strictly superficial variety of nævi; but it often fails in the mixed variety, because the supply of blood, coming as it does from below, is not arrested, and hence the vascular mark may shortly reappear. Again, the actual cautery is very serviceable, and it is recommended by some surgeons to thrust the heated metal in all regions of the vascular mass, central, deep, and superficial. A less heroic form of applying heat is found in placing sufficiently long needles under the growth, and heating the proximal ends with a spirit lamp. Free incisions have also been made in the tumour, and lint or sponge firmly inserted.

The treatment of nævi by the application of ethylate of sodium, introduced by B. W. Richardson, is one that deserves

consideration on the part of the surgeon, its great advantage being that it leaves very little scar, the skin becoming slightly wrinkled, and having the appearance of tissue-paper. The ethylate should be applied, not with a glass rod, but with a brush; the only trifling objection to the latter is that with one use it is destroyed. A quill pen may be advantageously employed.

3. *Injections*.—The next method of treatment is that of injecting some material, of a more or less stimulating character, into the substance of the growth. Numberless chemical agents have been employed with variable success; thus, tannic acid, a saturated solution of alum, carbolic acid and olive oil, dilute nitric acid, pure alcohol, or a strong solution of nitrate of silver are used. The injection of the tincture of the perchloride of iron has been extensively tried with varying results, but all observers now agree that there is some risk in its use, because of the intimate communication that exists between the reticular structure of the nævus and the veins, which are often large; and it is scarcely possible to be quite sure that the fluid is not injected straight into a large vessel. The risk may be reduced to a minimum by adopting the suggestion of first breaking up the tumour, either by vigorous compression with the finger and thumb, or with a couching needle, which is introduced and worked in a radiating or fanlike manner from a single orifice in the skin. The liq. ferri persulphatis has also been used as a good styptic injection. The tincture of iodine is also serviceable, inasmuch as it is not so active an agent as the preparation of iron, for it does not produce coagulation. The injection of liquor ammoniæ appears to be on the same dangerous footing as that of the liq. ferri perchloridi.

4. *Electrolysis*.—Another method which has of recent years attracted well-deserved attention is electrolysis. This method is most simple and efficacious, and while it may be employed with advantage in the superficial or cutaneous nævi, it holds the first place and is *par excellence* the best mode of dealing with the subcutaneous or mixed varieties. Its principle is to coagulate the blood. A Stöhrer's continuous battery may be employed, and about six or eight cells used if the battery is in good working order. One or two needles, which ought to be protected with some non-conducting material so as to preserve the skin, are attached to the negative pole, which is

best made of steel; and one to the positive, which is said to be better if made of gold or platinum, although a charcoal point is preferred by some. These are passed into the tumour. After the needles have been in for three or four minutes decomposition takes place—this is shown by bubbles of gas passing by the sides of the needles. The needles may be withdrawn and re-introduced, and if this process be carefully performed little or no blood exudes. The object of the operation is to produce a clot. It is well not to exceed six or eight cells at first, inasmuch as some children seem to suffer from shock during the operation. Further, if too many cells, say eighteen or twenty, are used, there is a prospect of suppuration. Between six and twelve cells, the writer believes, are the limits; but, as already observed, much depends on the quality and efficiency of the battery. See ELECTROLYSIS.

5. *Setons*.—Setons may be used advantageously in superficial or slightly mixed nævi, but it is important that the threads should be passed well below, and not through, the nævoid structure, their object being to obliterate the vessels passing to the skin-surface.

6. *Ligature*.—The elastic ligature is a favourite method with some surgeons, and is certainly suitable in many cases, but it is uncertain in its action. In treating cases with the ordinary ligature of hemp or silk, it is important to leave as little scar as possible; hence, if the ligature can be applied subcutaneously all the better, and it is worth a primary trial, even if there be a red superficial patch on the skin—i.e. a mixed nævus—because, as the blood-supply comes chiefly from below, there is a great probability that the ligature will not only destroy the subcutaneous growth, but will also eradicate the superficial red spot. Yet it cannot but be admitted that the subcutaneous ligature is often followed by failure, for it is by no means easy to comprise within its grasp one or more important vessels that principally feed the tumour; hence a second or even a third operation may become necessary. Nevertheless, if the operation be successful, the scar left after it is trivial, compared with the results that follow those operations in which the skin itself is included.

Subcutaneous Methods.—A needle in a handle is armed with a long piece of strong hempen thread, and is made to puncture the skin about a quarter of an inch from the circumference of the

nævus. It is then made to pass straight across under the tumour, and to emerge at a corresponding spot on the opposite side. The loop is now held in the left hand, and the needle is withdrawn, still armed with one thread. The needle is re-introduced at the first point of puncture, and is made to go (of course subcutaneously) round the circumference at the right side of the tumour, and to emerge at the same hole on the opposite side. The needle is then unthreaded and withdrawn. Thus there are a loop and one end emerging at one point, and a single thread emerging at the other. This single thread is now placed in the needle, which is again introduced at the first point of puncture, and carried round the circumference on the left side, being made to emerge as before at the opposite puncture. The thread is now removed and the needle withdrawn unarmed. There are now, of course, two apertures—one of entrance, which remains as a pinhole, and one of exit, at which are found the loop and two ends of the continuous thread. The operation is completed by passing the two free ends through the loop, drawing them tightly and tying them, not in a knot, but in a bow, so as to allow of them being tightened, if necessary, from day to day. By this ligature the tumour is cut into halves, and disappears by adhesive or suppurative inflammation.

Ligature involving Skin.—The well-known knot devised by Fergusson is one by which a radical cure may be readily effected. The only drawback to it is that by its use the skin is destroyed; but it is especially applicable to nævi situated on the trunk or other parts not usually exposed to view. Fergusson originally used a needle in a handle, but of late years preferred an ordinary surgical needle. Supposing the latter to be employed, the operation is thus performed:—The needle, having an eye of sufficient size to carry two thicknesses of thread easily, and threaded with a long and strong hempen ligature, is made to enter the skin about a quarter of an inch beyond the circumference of the nævus, under which it is passed. One thread of the loop, it matters not which, is now divided, and its opposite end threaded in the eye still armed. The needle, having now two threads, is made to pass at right angles under the tumour, and on emerging the threads are released. The corresponding ends having been selected, a groove is made with scissors at the circumference so as to receive the threads, and they are tied in a reef-knot as tightly as possible.

This method encircles the tumour and cuts it into four portions. It is important to tie the knots as tightly as possible, so as to ensure the rapid and complete destruction of the disease, and to give the patient as little pain as possible in the separation of the slough.

A modification of the above operation may be advantageously employed. It consists in passing two hare-lip pins under the nævus at right angles to one another, and encircling them with a ligature tied tightly in a bow; the needles are removed immediately after the application of the ligature, and the ligature taken away in twenty-four hours.

7. Enucleation.—This is a very old method of dealing with subcutaneous nævi, but John Bell's dictum of 'cutting out' the tumour and not cutting 'into it' has led surgeons to be over-apprehensive as to hæmorrhage. The idea of alarming hæmorrhage is greatly exaggerated. Some surgeons cut right through the diseased structure and take away each half piece-meal with curved scissors, removing no skin; or turn back rectangular flaps of skin, which should be retained even when involved in the nævoid growth.

8. Écraseur.—This instrument has been used, but can only be recommended in the case of very delicate children.

9. Ligature of Vessels.—1. The principal vessels supplying the nævus have been tied; thus in a case of nævus of the cheek, three needles were placed under the facial, left coronary, and angular vessels respectively, and a twisted suture employed. 2. The ligature of the main vessels has been attended with very negative results. Thus, the common carotid has been ligatured for tumours of the orbit and other tumours of the scalp; but, if this plan of treatment be adopted, it is obvious that the vessel selected should be one that directly supplies the growth, as, for example, the external carotid when any of its branches are involved.

10. Amputation.—This extreme measure can only be necessary in most exceptional cases, and should only be undertaken as a *dernier ressort*.

Summary of Treatment.—As the result of experience, it may be stated generally that for the superficial nævi, either strong nitric acid, the actual cautery, or the ethylate of sodium may be employed; and for the subcutaneous and mixed varieties, electrolysis, the ligature in some form, or enucleation may be practised.

FRANCIS MASON.

NAILS, Diseases of the.—The surgical affections of the nails will be described in the following order:—(1) Hypertrophy and deformity; (2) Onychia; (3) Ingrowing nail; (4) Eczema and Psoriasis; (5) Parasitic disease.

HYPERTROPHY.—Hypertrophy of the nail is not uncommon, and may depend on various causes which induce long-standing congestion of the matrix, or may be merely an accompaniment of old age. Very commonly the hypertrophy is attended by a deformed condition, the nail being irregularly developed and misshapen, becoming extremely thick, and assuming the character of a horn, variously twisted in different cases. Such nails, except from their size, may give no trouble; but, on the other hand, the edge may be directed against the skin, and then the pressure of the boot will cause a sore.

Treatment.—The projecting part of the nail may be removed by means of strong scissors—a groove having been first made with a sharp-edged file; or the nail may be completely removed. In some cases, after the last-named treatment, the nail may be reproduced in a normal fashion; but frequently it is impossible to cure the tendency to reproduction of the deformity, except by paring away the matrix or destroying it, as by strong nitric acid.

The nails sometimes become hypertrophied and misshapen as a result of local nerve-lesions, being remarkably curved and thickened, and in some instances ridged like an oyster-shell; this diseased condition being accompanied by withered and glossy skin and other results of injury to the nerves. The *treatment* is of course that of the nerve-lesion on which the deformity depends. See NERVES, Injuries of.

ONYCHIA.—This term is commonly applied to any long-continued inflammation of the matrix of the nail, which is accompanied by ulceration and its necessary results—purulent and more or less fetid discharge, with loosening and discoloration of the nail. As in many other affections of the nails, the appearances presented by the disease may be alike, although the causes are different. Thus simple, syphilitic, and strumous onychia have been all described.

In a typical and severe case (*onychia maligna*), the extremity of the affected finger is inflamed and bulbous, dark red or livid; foul sanious matter escapes from beneath the nail, which is partly raised from its bed by granulations springing from the ulcerated matrix. All the parts are acutely tender, the patient shrinking from the

slightest touch. Cases such as this are seen most frequently in children, and more often in the fingers than the toes. The disease will be found usually to have begun as a consequence of some injury, as from a squeeze of the finger in a door or from its being trodden upon. In rare cases, the disease may advance until necrosis of the last phalanx occurs.

It is not necessary to assume the presence of a constitutional defect in all cases of onychia; but the possibility of a predisposing cause in the form of struma or syphilis should be borne in mind, and especially when more than one digit is affected. In a case of syphilitic onychia, the symptoms are generally far less acute than when the disease has been caused by injury; and the diagnosis is made sufficiently easy by the presence of other signs of syphilis in the neighbourhood or elsewhere.

Treatment.—The finger should be well fomented with a weak lotion of permanganate of potash or carbolic acid, and a piece of lint dipped in an arsenical lotion (liq. arsenicalis f3j., aq. ad f3j.) should then be applied, the process being repeated twice or three times daily; or, instead of the arsenical lotion, powdered nitrate of lead or iodoform may be dusted over the part. If the disease does not yield to this treatment, the nail should be removed, and the same treatment continued. In syphilitic onychia, black wash or calomel is the best local application; and a course of mercury or iodide of potassium should be given internally. In strumous or cachectic subjects, good food, cod-liver oil, steel, and arsenic are indicated; the local treatment resembling that proper for the simple form of the disease.

In the majority of cases, onychia can be cured by the above-mentioned treatment without much difficulty. In a small number of cases, however, there is some inherent vice in the matrix which leads to a redevelopment of the disease, notwithstanding all treatment; and the only effectual method of cure consists in removal of the matrix, by shaving it off with the knife or destroying it by caustics, of which nitric acid is the best.

INGROWING NAIL.—This term is applied to a very painful affection, in which the irritation caused by the edge of the nail pressing against the soft tissues ends in ulceration with exuberant granulations. The sharp edge of the nail impinges against the ulcerated surface of the skin which overhangs it, not by growing into it, but by the granulations growing out against the edge of the nail. The disease is practically con-

fined to the great toe, and almost invariably to its outer side. When the disease exists elsewhere, it is complicated by some diseased condition of the matrix. Predisposed to by an unusual development of the skin which naturally overhangs the nail, the trouble begins as a consequence of some slight injury, as from the pressure of tight boots or the like.

Treatment.—In a simple case, the edge of the nail should be cut away when any soreness is felt; but when the disease is fully established, and the edge of the nail overlapped by granulations, a more formal operation must be undertaken. Nitrous-oxide gas having been given, or the toe frozen, a slip of the entire length of the nail must be removed by pushing one blade of a pair of scissors beneath it, and twisting off this portion from the matrix with a pair of torsion-forceps. The slip removed should not be more than a fourth, or at most a third, of the nail; and, even if both sides are operated on, a useful central portion will be left. A radical cure can be produced by carrying the scissors well into the matrix of the nail and removing the lateral portion. When there is much overlapping of the skin, a small flap may be sliced off with a scalpel. *See* INGROWING TOENAIL.

ECZEMA AND PSORIASIS OF NAILS.—Any long-continued, however slight, disease of the matrix will produce alteration in the texture and appearance of the nail; and as the altered nail is but a deformity resulting from a disease not primarily in itself, but in the underlying parts, it is only possible to get an accurate idea of the primary disease by studying the condition of the surrounding integuments. Thus, a rugged, furrowed, and brittle condition may be due in one case to eczema, in another to psoriasis, and in another to favus or ringworm, the appearances in all being not very different. Hence the impossibility of describing, in any useful way, the appearances of so-called eczema or psoriasis of the nails. They must be diagnosed in connection with the disease of the vascular tissues in their neighbourhood.

Similar appearances of the nails are sometimes present (and often called eczema or psoriasis) when there is no obvious eczema or psoriasis elsewhere. In such cases, most careful examination should be made with reference to the possibility of local irritation by extraneous matters accidentally applied, the nature of the patient's employment sometimes giving a clue to the source of the disease; or the disease may be parasitic.

Treatment.—When eczema or psoriasis of the nail is accompanied by a like disease elsewhere, the general treatment is obvious. The nails should be kept short, and occasionally softened by applying lint soaked in some alkaline wash, as of bicarbonate of soda (3ss. to f3j. of water). Accumulations of scales, &c., should be removed carefully by a nail-cleaner (made of bone or ivory, not steel). Lotions such as the following should then be tried:—*Liq. carbonis deterg.* f3ss.-f3j., *glycerini* f3j., *aquam ad* f3iv.

The disease is generally obstinate.

PARASITIC DISEASE.—The appearance of a nail affected by parasitic disease is sufficiently like that produced by long-standing irritation from other causes (eczema, psoriasis, &c.) to lead easily to an error in diagnosis. The possibility of the presence of a parasite should, therefore, be always borne in mind. A clue will usually be obtained from the presence of the disease (favus or ringworm) elsewhere: tinea of the nails, for example, in a child being accompanied usually by ringworm of the scalp. But in all doubtful cases a careful microscopic examination should be made of scrapings from the diseased nail; after softening and getting rid of extraneous fatty matters, by the application to the specimen first of ether for a few minutes, and subsequently, for some hours, of liquor potassæ.

Treatment.—The treatment of parasitic disease of the nails resembles that of the same disease when in the scalp or elsewhere. But the uncertainty is greater on account of the difficulty in thoroughly applying anti-parasitic remedies to the diseased surface. Great care should therefore be taken in scraping away the diseased portion of the nail, after softening by means of warm water and alkaline lotions, and in applying the remedies as thoroughly as possible. *See* TINEA TONSURANS; FAVUS.

W. MORRANT BAKER.

NASAL BONES, Fractures of the.
See FACE, Fractures of Bones of the.

NASAL DOUCHE.—To wash out the nose effectually and comfortably, certain simple precautions are to be observed. This process may be required for hæmorrhage, whether accidental, operative, or spontaneous, and is of important use in catarrhal and ulcerative inflammation, especially in the chronic fetid form known as ozæna.

A stream of water or lotion may be passed in at one nostril and out at the other, without impeding the respiration of

the patient if the latter assume the proper attitude, sitting or standing with the chin over the edge of a basin, bucket, or sink, the neck flexed, and the mouth open for breathing purposes. Another vessel contains the water or lotion, which should be an antiseptic liquid, not strong enough to cause pain, but strong enough to disinfect. Nothing is better than a solution of chloride of zinc, averaging an eighth of a grain to the ounce in strength. For hæmorrhage the hottest water that can be borne is far better than cold or iced. In any case plain water does very well to begin with, especially if there be pus, mucus, and scabs to be cleared away. The feeling of the patient may be consulted as to the temperature of the liquid, when used for allaying decomposition and inflammation. Hot or warm liquids, when not demanded for hæmostatic purposes, are better avoided when disliked; for some persons thus experience pain, who can bear and even enjoy cold or iced liquid in a state of nasal catarrh.

The liquid may be washed through the nostrils, in the attitude of the patient as above described, by means of a Higginson's syringe, a convenient method for the surgeon. But when undertaken by the patient, the syphon-tube is invaluable and may be required several times daily. A yard or a yard and a half of india-rubber tubing, transmitting a stream an eighth to a quarter of an inch wide, is slung over the edge of a jug containing the liquid, placed on a shelf or hung against the wall above the patient's head. One end of the tube is weighted, and reaches from the bottom of the liquid to the edge of the vessel, round which it may be curved by inserting six or eight inches of wire to prevent acute flexion and obstruction. The other end reaches from the edge of the vessel to the nose of the patient, and should be considerably longer than the immersed end, to permit syphon-flow when once the tube is filled throughout, and this is readily effected by the patient closing the mouth and opposite nostril temporarily, and taking a deep inspiration through the tube. The tip of the longer end should have a suitable nozzle, ending in an india-rubber 'teat' with a large central hole of a size suited to the nostril.

Nasal douche tubes are specially constructed with neat vulcanite or metal fittings. These consist of a piece of bent stiff tube to hang over the edge of the vessel, or, in the case of a mere stiffening of wire inside the tube at the flexure, a weighted inverted funnel to ensure deep immersion

of the short end of the tube. In either case a nozzle is fitted to the long end. The force of the continuous stream thus produced can be modified by varying the height of the vessel.

RUSHTON PARKER.

NASAL POLYPUS is a growth from the lining of the cavity, more or less pendulous, encroaching upon the breathing space, and on that account accompanied by arrest or modification of nasal respiration. The vast majority are gelatinous-looking objects which can be seen on inspection through the nostril, their presence being first indicated by their obstructive effect. Their point of attachment can never be seen when they are inspected *in situ*, but it is found to be usually on the upper and middle turbinate bones, and, less frequently, the inferior turbinate. Their surface is the mucous membrane of the nose, of which the ciliated epithelium shows abundant vibratile motion when examined microscopically, in a liquid, shortly after removal. Their gelatinous-looking substance is the loosest form of connective tissue, holding mucus in its meshes, and often resembling that class of tumours known as myxoma. They are, probably, mere hypertrophic excrescences of the submucous connective tissue, growing under the stimulus of some constant irritation, and owing their pendulous character to their composition and attachment.

Polypi are common at most periods of life, except in childhood and old age, and may exist in one or both nostrils, singly or in a group. Their lower extremity occasionally becomes excoriated, inflamed, and indurated or distended with blood, presenting, on inspection, under these circumstances, a momentary resemblance to some malignant growths. By pressure upon adjacent parts of the nose they may be attended by a mucous or purulent catarrh, with, in rare instances, ulceration, and even perforation, of the septum.

The *treatment* of polypus is removal, effected by constriction with a wire-loop snare, or by the use of suitable forceps. Satisfactory removal can be practised by either method, and, in some cases, with very little pain or inconvenience to the patient, followed by great subsequent comfort, which is now and then permanent after a single operation.

In using the snare, the wire is passed into the nostril along the floor of the nose, the loop being adjusted as long and as wide as the parts will allow, and then is passed upwards so as to surround the pedicle. This is divided, on constricting the loop, by

means of the *écraseur*, of which it is commonly a part, or, in default of this, by means of a simple piece of metal tubing, such as a piece of broken catheter, which can be slid along for the purpose.

In removing polypi otherwise, a pair of dressing-forceps is more frequently employed than anything else. Such an instrument, finely shaped and fairly long in the jaws, which should be serrated in their whole length, is more convenient than the short, thick sizes. It is not, however, sufficient to deal with polypi from the front, but the left forefinger should be passed behind the soft palate and made to meet the forceps, so as to insure clearing the posterior nares and pharynx, into which large pendulous nasal polypi often hang.

However removed, these 'gelatinous' or 'mucous' polypi, as they are called, have a tendency to be reproduced, at longer or shorter intervals, and accordingly various substances are applied with the view of preventing their re-formation. Tannic acid and sulphate of zinc have been recommended as snuffs. Salicylic acid, also as a snuff, has been used with advantage by the writer; and lotions of perchloride of iron, boracic acid and alcohol, carbolic acid and glycerine, have been known to act satisfactorily in arresting the growth of polypi. The same methods of local medication have been employed in the first instance, the persistent use of tannin snuff having been followed by sloughing and separation of the polypi; and injection of the above lotions into the substance of the growths, by means of a subcutaneous syringe, has resulted in their shrinkage and disappearance.

Other *non-malignant growths* of firmer consistence, and commonly called 'fibrous' polypi, are sometimes met with. They do not arise from the turbinate bones or outer wall, but from some part of the roof, from the margin of the posterior nares, or adjacent pharynx, in which case they are 'naso-pharyngeal' polypi. They are much less frequent than the mucous, much less easy to remove, but still capable of effectual extirpation, although they are commonly attached to the bone beneath them.

Treatment.—Extirpation alone is here practicable. If the growth be pendulous, or have a narrow attachment, the wire snare, plain or galvano-caustic, may be satisfactorily used for the purpose. Certain examples may be removed easily with ordinary dressing-forceps, or the special form alluded to. But, in the event of inaccessibility by what may be called the blind

method of removal, inspection and direct excision should be practised. Some have slit the nostril up towards the eye, others have excised the upper jaw, or temporarily turned aside that bone, subsequently replacing it with its attached soft parts. By all these methods the nasal cavity can be exposed and explored.

But a far better method of entrance into, and inspection of, the nose for foreign bodies as well as tumours within it, is through the mouth under the upper lip, the fold of which is divided along with the nasal cartilages at their attachment to the bone. The nose is raised up with the lip, and a good view can be obtained throughout the nasal cavity, from which the tumour can be removed to its finest detail, without external mutilation of any kind. The writer's personal experience of this method has convinced him of its excellence.

Malignant tumours of the nose, whether polypoid or not in form, are of much less interest than others, being, fortunately, much less frequent, though hardly amenable to treatment at all, and being generally liable to rapid recurrence and eventual fatality. They can be recognised pretty easily by their rapidity of growth, by their tendency to bleed, and sometimes to infect the lymph-glands of the neck behind the angle of the jaw. When purely nasal, their removal may be practicable, and sometimes advisable, by the method beneath the upper lip, as above described, especially if situated far back. If situated in the upper and anterior parts of the nose, it may be easier to operate by direct entrance from the face. See *ROUGE'S OPERATION*.

Such tumours, though arising in the nose, are not infrequently attached to the superior maxillary bone, invading the antrum, or other parts beyond the nasal cavity. In that event, excision of the upper jaw is required, by the methods detailed in the article on the subject (*see JAWS, Operations on the*).

The obviously malignant growths are generally carcinomata, arising from the nasal mucous membrane, exhibiting in their minute anatomy the general characters variously found in carcinomata, with the special features derived from the surface from which they grow. Others have an adenomatous structure and a doubtful malignancy, neither of which can be decided until after operation, the former by microscopical examination, the latter by clinical observation, and waiting for recurrence or its fortunate absence.

RUSHTON PARKER.

NASO-PHARYNGEAL CATARRH.

See RETRONASAL CATARRH.

NASO-PHARYNGEAL GROWTHS.

1. NASO-PHARYNGEAL VEGETATIONS are small pendulous or sessile growths, produced by hypertrophy of the adenoid tissue so abundant in the vault and sides of the naso-pharynx.

Cause.—Hardly known. They are most frequently met with in cold and damp climates, and then generally in delicate children. Colds, the acute exanthemata, and local irritation from food and cold air in cases of cleft palate, have been ascribed as causes. Some regard them as congenital, some as hereditary, and some, but apparently without sufficient evidence, as of strumous or syphilitic origin.

Pathology.—The vegetations occur in greatest abundance in the region of the pharyngeal tonsil, but may also be found on the lateral walls of the pharynx and about the orifice of the Eustachian tubes. They may be soft and friable, or hard and tough, and are generally very vascular. Microscopically, they consist principally of retiform adenoid tissue containing large numbers of lymph corpuscles, with here and there closed follicles similar to those of the tonsil.

Symptoms.—These vary according to the age of the patient, the amount of obstruction to nasal respiration, the vascularity of the vegetations, the copiousness of the secretion, and the condition of the mucous membrane lining the Eustachian tube, middle ear, lower pharynx, and nasal cavities. In a well-marked case, the voice has what Meyer calls a 'dead' character. It is muffled, the nasal resonance is lost, and the *m* and *n* sounds are pronounced as *b* and *d*. The face, from the patient breathing with the mouth constantly half-open, assumes a characteristic vacant expression, similar to that familiar to all in the case of enlarged tonsils; pellets of mucus, often tinged with blood, are constantly hawked up; and blood is occasionally found in the mouth or on the pillow in the morning. More or less deafness is frequently present, and it is often for this that medical advice is first sought. In infants, obstructed and noisy respiration and snoring during sleep should call attention to the affection. Granular pharyngitis, enlargement of the tonsils, and hypertrophic nasal catarrh are not uncommon concomitants; and purulent otitis with permanent impairment of hearing may result if the affection is neglected. A peculiar malformation of the chest,

similar to that which may be met with as a consequence of enlarged tonsils, has not infrequently been observed.

Diagnosis.—The growths can be readily detected by the finger passed behind the palate, and when abundant do not feel unlike, as Meyer expresses it, a bunch of earth-worms. The examination is generally attended with bleeding. In the rhinoscopic mirror they appear as fimbriated fringes, or flattened elevations of a pale, pink, or dark red colour, often encroaching more or less over the posterior nares and orifices of the Eustachian tubes.

Treatment.—The vegetations may undergo atrophy as the patient gets older, or cease to cause obstruction as the naso-pharynx increases in size. But, as the deafness and other symptoms to which they give rise may in the meantime become permanent, they had better be removed as soon as detected. When soft and small, and not very numerous, they may sometimes be got rid of by means of astringent injections or by the application of solid nitrate of silver. The former may be applied by Meyer's tube, which is passed through the nose, or by a post-nasal syringe. But injections, to be of any service, must be persevered in for long periods. If nitrate of silver is used it should be applied fused on the end of a long and suitably bent probe, as the use of all caustic-holders is attended with danger. It should be continued as long as bleeding follows its use. Usually more active treatment is called for. Thus, the softer growths may be scraped off by the finger-nail, a method especially useful in the case of very young children, where the parts are small and rhinoscopy difficult. For tougher and firmer growths, some cutting instrument or the galvano-cautery is necessary. Those situated on the vault may safely be removed by most of the methods that have been recommended; but extirpation by Löwenberg's or Woake's forceps, especially when the growths are of any size, is perhaps the best. When the patient is tractable, and a rhinoscopic examination can be obtained, the forceps may be directed by the mirror. Otherwise chloroform had better be given, and the forceps can then be guided either by the mirror, or by the finger passed behind the palate. Growths on the lateral walls and about the Eustachian tubes must be dealt with more carefully, as here there are important structures in relation with the pharyngeal walls, and an injury of the Eustachian tube may lead to inflammation and even suppuration in the middle ear. In such cases, the patient should

always be placed under chloroform, and the growths destroyed either by a small galvano-cautery, accurately directed by the rhinoscopic mirror, or by Zauffal's nasal speculum, or, as some prefer, by Meyer's ring-knife, which is passed through the nose. To obtain space for the mirror, the palate may be drawn forward by the palate-hook, or better, by fine india-rubber tubing passed through the nostrils out at the mouth and fastened across the lip, the latter method allowing the surgeon the use of both hands. Should any unusual hæmorrhage follow the removal of the growths, it may be arrested by astringent injections, tannic acid insufflations, &c. The patient should be instructed to breathe through his nose; and it may be useful to keep the mouth closed during sleep, either by securing the jaw by a four-tailed bandage, or by the use of the 'contra-respirator' advised by Guye.

2. NASO-PHARYNGEAL TUMOURS OR POLYPI. The term naso-pharyngeal polypus is commonly applied to any tumour growing in the upper part of the pharynx. Such tumours have generally a fibrous or a fibromucous structure; but sarcomatous, carcinomatous, and still more rarely enchondromatous growths may occur. The naso-pharynx may, moreover, be invaded through the posterior nares by mucous polypi, or by malignant or other growths originating in the nasal cavities or antrum.

(a) *Fibro-mucous Polypi.*—These consist of a mixture of fibrous and myxomatous tissue, and commonly spring from the mucous membrane about the posterior nares, which has a structure intermediate to the soft pituitary membrane of the nose and the more fibrous covering of the vault of the pharynx. They are usually smooth, of a soft fleshy consistence, reddish in colour, and ovoid in shape; they are generally pedunculated and hang loosely in the pharynx, sometimes projecting below the soft palate, but more rarely they have a broad base, and send processes into the nasal cavities.

Symptoms and Diagnosis.—Fibro-mucous polypi may give rise to symptoms similar to those of the fibrous variety to be next described. Unlike the latter, however, they are not attended with hæmorrhage, and have no tendency to displace and destroy surrounding parts. They feel, moreover, less firm and resisting to the finger introduced behind the palate.

Treatment.—They may generally be twisted off by the finger or forceps passed behind the palate. If their base is too

broad to admit of this, it may be severed by the galvanic écraseur, in the way described in the next section.

(b) *Fibrous Polypi.*—These generally spring from the periosteum covering the basilar process of the occipital or body of the sphenoid bone, and consist of tough fibrous tissue without elastic fibres, and often intermixed with sarcomatous elements. Their vessels have usually very thin walls, and in some instances are so numerous in parts of the growth as to give it a cavernous structure. They are smooth and firm, and covered with a very vascular mucous membrane, which gives them a dark red colour, while their surface is sometimes eroded by ulceration. They may be either pedunculated or sessile, and at first are usually confined to one side of the pharynx; but as they increase in size they form secondary attachments, displacing and destroying the surrounding bones, encroaching upon the nose, mouth, orbit, or speno-maxillary fossa, and sometimes protruding externally through the nostrils or cheek, or upwards into the cranium. They generally occur in young adult life, grow slowly, are very liable to return after removal, but show a tendency to atrophy after the age of twenty-five. They have occasionally sloughed away spontaneously, and have then shown no signs of return, even after many years.

Symptoms and Diagnosis.—At first there may be no symptoms, but later headaches, drowsiness, and obstruction of one or both nostrils supervene, accompanied by a mucous and often fetid discharge, and frequent attacks of epistaxis. Occasionally, the polypus may be seen through the nose or projecting below the palate; otherwise it may be detected by the rhinoscope, or by the finger introduced behind the velum. As it encroaches upon surrounding parts it may give rise to deafness, difficulty in deglutition, and dyspnoea; whilst the eyeballs may be protruded, the facial bones widened out, and the nose flattened, causing the characteristic deformity known as 'frog-face.' The determination of its attachments now becomes very difficult, but may be facilitated by manipulation with a suitably curved probe. The repeated hæmorrhages produce severe anæmia, and the patient, if not relieved, may die of exhaustion.

Treatment.—When small and pedunculated, a fibrous polypus may sometimes be torn off by the forceps introduced behind the palate. When, however, the attachments are at all extensive, this method should not be attempted, as it may be attended with

profuse hæmorrhage, and, when the bones of the cranium have been invaded by the growth, by fatal inflammation of the brain. For these the galvanic *écraseur* should be employed, the wire loop being passed through the nose, and directed round the base of the polypus by the finger in the pharynx. The stump left after the severance of the growth should then be completely destroyed by the post-nasal galvanocautery, passed behind the palate. The patient should be subsequently carefully watched, and the cauterisation repeated should there be any sign of a return of the growth. When the polypus is too large for removal by the natural passages, the soft palate may be split and, if necessary, part of the hard palate cut away, and the growth then removed by the ordinary or by the galvanic *écraseur*, and the base scraped away from the bone or destroyed by the actual or galvanic cautery. When the growth has taken a forward direction, invading the nose, it may be exposed by turning up the ala of the nose, or by Rouge's method; or, if sufficient room cannot be thus gained, by the removal or resection of the superior maxillary bone after the method of Langenbeck. If the patient is weakened by repeated hæmorrhages so as to be unable to bear a serious operation, electrolysis may be tried—a procedure which, though not invariably successful, has been attended with some brilliant results. Under its use the hæmorrhages have been arrested, and the polypus sufficiently reduced in size to allow it to be removed through the natural passages.

(c) *Malignant Polypi*.—These have generally a sarcomatous or, more rarely, a carcinomatous structure. It is not always possible to diagnose them from fibrous polypi before removal. They grow more rapidly, however, and there is often glandular enlargement and severe pain. Where a small piece of the growth can be removed, a microscopical examination will generally clear up any doubt. When seen early, they should be widely extirpated by one of the methods above described. If they have attained any size, they are beyond the aid of surgery.

W. J. WALSHAM.

NAVEL. See UMBILICUS.

NECK, Diagnosis of Swellings and Tumours of the.—The character of many of the enlargements met with in the neck is in some measure indicated by their position. Thus, bronchocele will be found in the situation of the thyroid gland, while aneurisms are more frequent at the root of the neck. The colour and appearance of the

skin will show the approach of inflammatory swellings to the surface, and in some cases the infiltration of cancer will be recognised in the same way. Upon palpation it will be readily ascertained whether the tumour is fluctuating or solid, or whether it presents a combination of these two conditions. In rare instances, the presence of air in the tissues may be detected by the peculiar crackling sensation communicated to the fingers. This may be due to emphysema from rupture of some part of the air-passages. Hernia of the mucous membrane of the trachea has also been recorded, and occasionally the apices of the lungs can be felt above the clavicles, especially when they have become emphysematous from some intra-thoracic disease. The most important fluid swellings are as follows:—

1. *Abscesses*, which are usually known by their painfulness and rapid growth, together with the signs of inflammation which accompany them. As they generally begin in lymphatic glands, their recognition will be assisted by the detection of any local lesions which may have set up lymphatic irritation.

2. *Cysts*.—Cutaneous sebaceous cysts present no difficulty. Hydrocele of the neck, which is a large collection of serous fluid contained in a single or multilocular sac in the anterior or posterior triangle, is known by its slow and painless growth and by the clear straw-coloured fluid which escapes from the canula when it is punctured. Many are congenital, and they may be associated with solid growth of a sarcomatous type. In the submaxillary triangle ranulæ may protrude as well as in the floor of the mouth, and occasionally deep-seated sebaceous cysts are also found in this region. Bursal tumours may form between the hyoid bone and the thyroid cartilage, and upon the ala of the thyroid cartilage. These, as well as the more common cysts of the isthmus and lobes of the thyroid gland, may be known by their moving with the larynx in swallowing. In hydrocele of the neck and thyroid cysts the contents may be of a bloody character, and blood-cysts are sometimes found, which have resulted from the degeneration of nævi. Hydatid cysts and cysts of the *cysticercus cellulosæ* may occur in the neck. They are very rare, and will probably not be recognised until a puncture has given exit to clear watery fluid, containing hooklets or pieces of cell-wall.

3. *Aneurisms* are known by their expansile pulsation, and by their position upon the course of great arteries. At the

root of the neck they may be in connection with the arch of the aorta, the innominate, the subclavian, or carotid arteries. Bruits heard upon auscultation, and differences in the character of the radial pulse of the two sides, will assist the diagnosis. There may also be evidence of pressure upon the recurrent laryngeal nerve. There will be less difficulty in recognising the position and character of the disease when the distal portions of the carotid or subclavian arteries are affected.

The *solid* swellings may be classified as follows:—

1. *Glandular*.—These are usually the result of chronic inflammation, and they are frequently associated with scrofula or syphilis. Some are secondary to malignant affections in their vicinity. Cancer of the lip or tongue is the most frequent cause of these enlargements in the upper part of the neck, while the supra-clavicular glands may be implicated in scirrhus of the breast. Enormous growths of a primary character are found in the various forms of lymphadenoma. Some of these are very malignant, infiltrating the deeper structures as well as the integuments.

2. *Nævi* and other tumours of the skin and subcutaneous tissue are frequent. Papillomata are sometimes observed, which appear to have some connection with the branchial clefts of the developing foetus.

3. *Lipomata*, which may be of the common lobulated and encapsuled form. It is in this region, however, that we generally find the rarer diffused fatty tumour. This may either invade the front of the neck, where it looks like an enormous double chin, or it may form an unsightly prominence covering the nape of the neck. Small masses of fat have been observed in the supra-clavicular regions associated with absence of the thyroid body, in sporadic cretinism.

4. *Bronchoceles*, which will be recognised by their position and by their movement during swallowing.

5. *Growths in Muscles*.—Gummatous swellings due to tertiary or hereditary syphilis may attack any of the muscles, and in infants the sterno-mastoid is especially liable to localised induration, which may sometimes arise from congenital syphilis; but far more often it is produced by severe strain during the process of parturition, such as the traction upon the muscles while the head is being delivered in a footling presentation.

6. *Malignant and semi-malignant tumours*, of which the sarcomatous affection

of the lymphatic glands already mentioned is the most common form. Epithelial cancer sometimes occurs primarily in the skin, or it may spread from some deeper seat in the air and food passages. The implication of adjacent tissue and glands, the age of the patient, and in many cases the rapid growth, will assist the diagnosis of these tumours. N. DAVIES-COLLEY.

NECK, Inflammatory Affections of the.—Cutaneous erysipelas rarely attacks this region except when it spreads from the face. Erysipelatous and phlegmonous inflammations of the fauces are apt to invade the larynx, where they give rise to grave symptoms, from œdema glottidis.

Stiff-neck is a congestive inflammation of the fascial or muscular structures, due to cold draughts, chills after exertion, or strains, especially of the sterno-mastoid muscle. It comes on suddenly, with a good deal of pain, which is aggravated whenever the patient attempts to move his head from the constrained position in which it is held by the spasmodic contraction of the muscles. Usually it disappears spontaneously in a day or two, but more rapid relief can generally be procured by warm applications, or, still better, by the domestic remedy of covering the part with flannel, and then ironing it over with an ordinary flat-iron as hot as can be borne. A gentle aperient, followed by half-drachm doses of citrate of potash, will also be beneficial.

Abscesses of the neck may be diffused or circumscribed. The latter are usually set up by inflammation of the lymphatic glands, which are very abundant in the deep as well as the superficial strata. In the upper part of the neck, abscesses are frequently secondary to ulceration of the mouth, fauces, and pharynx. If farther back, they are often caused by eruptions of the scalp. Alveolar inflammation and necrosis of the lower jaw occasionally give rise to abscesses in the submaxillary region. At the root of the neck, abscesses may receive an impulse from the subjacent arteries, and there may be considerable difficulty in distinguishing these from aneurisms. Diffuse suppuration may originate in the glands, but it is more often the result of a contusion or exposure to draughts. It is usually met with in adults of a somewhat enfeebled constitution. There is rapid swelling, with redness of the skin and brawny hardness, which is soon followed by softening and fluctuation. The tissues involved are generally beneath the deep fascia, and they may be either in the space which intervenes

between this and the fascia investing the depressors of the hyoid bone, or still deeper, beneath both the fasciæ. In the latter case, there is great danger of the inflammation spreading down into the mediastinum and lighting up pleurisy or pneumonia. Sometimes also death has occurred from the perforation of one of the large vessels of the neck.

Abscesses should be opened early, to prevent their spreading beneath the fascia, and also on account of the unsightly scars which they leave behind when allowed to make their way to the surface. It is still more important to give exit to the matter by early incision when the suppuration is diffuse. In many cases this treatment should be adopted even before the brawny swelling has begun to fluctuate, and, after the incision, careful provision should be made for the free discharge of the matter through drainage-tubes.

Occasionally abscesses develop at a still greater depth, beneath the prevertebral fascia. They are usually the result of disease of the bodies of the cervical vertebræ. By bulging forwards they obstruct the pharynx and œsophagus, and thus hinder the passage of food. They also tend to spread sideways and reach the surface in the posterior triangle of the neck; or they may run downwards into the posterior mediastinum, and burst into the pleura or pericardium. As soon as a fluctuating tumour is detected at the back of the pharynx, it should be opened in the middle line by a knife introduced through the isthmus of the fauces; or an attempt may be made to open it aseptically by dissecting down upon it from the posterior triangle of the neck, and introducing a drainage-tube.

N. DAVIES-COLLEY.

NECROSIS.—Necrosis is the term used to denote, in bone, what is expressed by the word sloughing when speaking of the soft tissues. It implies that a portion of bone has died *en masse*, whereas caries signifies molecular death or ulceration. Thus necrosis and caries of a bone have their counterparts in sloughing and ulceration of the soft tissues.

Necrosis may affect only the cortical part of bone, and is then called peripheral. This is probably the most common form. The cancellous tissue alone is rarely involved, except in a localised osteomyelitis, in which case it might be called 'central necrosis,' but the symptoms, pathology, and treatment are the same as in chronic abscess. When the whole thickness of a

bone is necrosed, as sometimes occurs in acute diffuse periostitis, it is called 'total necrosis.'

Causes.—Necrosis is much more common in some bones than others, the long bones being by far the most frequently affected, whilst the short and flat bones are, comparatively speaking, but rarely so diseased. No age appears to be really exempt, but the young undoubtedly suffer most. Between the ages of twelve and eighteen it is most common, attacking the poor and ill-nourished with far greater frequency than the healthy and well-to-do.

Everything which tends to interrupt or impede the circulation and nutrition of a bone, whether it be in the periosteum, medulla, or in the bone itself, may give rise to necrosis. Thus it is a common sequel to the various inflammatory diseases of bone, but it may also occur by extension of inflammation from the surrounding parts, as in whitlow. Of external causes, injuries such as wounds, bruises, compound fractures, amputation, and gunshot injuries, are the most frequent. Extreme degrees of heat and cold, such as frost-bite and burns, may also give rise to necrosis. Of internal causes, the specific fevers are the most definite. During convalescence from scarlet fever, measles, smallpox, typhoid, typhus, and rheumatic fevers, some inflammation in one of the long bones or its periosteum is not infrequently observed. This may end in the death of a small portion of bone.

Syphilis also gives rise to necrosis by ulceration and destruction of the soft parts over a bone, or by inflammation of the periosteum, as is described under chronic PERIOSTITIS, or by condensing OSTITIS, a disease in which the Haversian canals may become so nearly obliterated as to lead to obstruction of the circulation in a portion of the shaft. Mercury and phosphorus have also been known to cause necrosis, but are now more rarely the direct exciting causes than they were in former times. Other constitutional states there may be, which predispose to inflammation of bone and its consequent death; but little more can be said, except that feeble, ill-nourished children of the strumous type are more prone to it than the healthy and robust.

Pathology.—The inflammatory conditions of bone, which may arise from any of the above causes and produce necrosis, have been described under OSTITIS, PERIOSTITIS, and OSTEOMYELITIS, and need not be repeated here. A portion of bone being dead, either as a direct consequence of inflammation, or, as in a compound fracture,

from its exposure and separation from the periosteum and surrounding parts, we have now to consider how the dead is separated from the living bone and removed from the body. The process is accomplished by inflammation and suppuration, if this condition be not already present as the exciting cause of the necrosis. The living bone and periosteum surrounding the dead become inflamed. That part of the inflamed area which is in immediate contact with the dead breaks down into pus, whilst the peripheral or outlying part is forming new bone. The various stages of the process will be found described under rarefying OSTITIS.

As the Haversian canals dilate and inflammatory exudation is poured out into the tissue surrounding the vessels, new capillary loops are formed and become covered with leucocytes. This inflammatory new-formation is converted into granulation-tissue, which, eventually producing fluid pus, forms a line of ulceration separating the dead from the living bone. In the peripheral parts, especially in the periosteum covering the dead bone, the inflammatory new-formation, instead of becoming granulation-tissue, develops into new bone invaginating the old. This new bone forms a more or less complete casing, leaving an aperture here and there for the escape of pus. These openings are called 'cloacæ,' and the dead bone locked up within the new ensheathing bone, when loosened from its surrounding parts, is called a 'sequestrum.'

On the superficial aspect of the tibia, if the periosteum has been destroyed, this invaginating sheath may be absent, and the dead bone is not encased as above described. Exfoliation, which is the term used to express this process of removal without invagination, occurs also not infrequently in the skull. It is, however, only in the superficial or peripheral necroses that such exfoliation can occur. Reproduction of bone after the removal of the sequestrum is generally fairly perfect. The periosteum being the principal agent in the formation of this new bone, we find that in the cases of exfoliation, especially of the tibia and skull in which the periosteum has been completely destroyed, the gap is generally filled up by granulations which organize into a firm fibroid tissue. In the deeper parts of this new cicatricial tissue some bone is reformed, but to a great extent a groove in the bone remains, which is filled as above described. This is especially so in the case of the skull. In cases of total necrosis, where there is a perfect invaginating

sheath, the reproduction of bone is almost perfect, even when the necrosis has involved the whole shaft from epiphysis to epiphysis, provided the epiphysis itself and its cartilage are intact. In cases where the epiphysis is involved and partially or completely destroyed, the reproduction is more or less imperfect.

The *symptoms*, at first, are generally those of one of the antecedent inflammations of bone, and presumably the abscess that has formed has been opened, or has been discharged without the surgeon's assistance, before coming under observation. He has now to consider the best means for detecting the presence of dead bone beneath, its probable size and character, and the possibility of its being loose and fit for removal.

Firstly, with regard to the actual presence of dead bone; the history of an attack having the characters of one of the inflammations of bone would point in this direction. One or more sinuses having button-like, pouting granulations, with considerable enlargement of the bone beneath, would increase the probability; and the introduction of a probe, which strikes with a clear ringing sound upon the hard non-vascular sequestrum, will confirm the opinion already formed.

Secondly, as to its size and character; a small and superficial necrosis will be attended with a small amount of discharge, and very little enlargement of the bone affected; there may be few openings close together, or possibly only one sinus may be present. Moreover, it can be seen and felt quite close to the surface. In the case of a large extent of both surface and thickness, as in total necrosis, there will be a very copious discharge, a large development of new bone, and several sinuses at considerable intervals from one another; and, on examination, the probe will pass through new bone for some distance before it strikes upon the sequestrum.

Lastly, its fitness for removal will depend on whether it has become loose. The length of time that has elapsed, since suppuration was first fully established, will be the first point for consideration. In the very young, necrosed bone is much more quickly separated from the living than in the young adult. The rapidity diminishes with age till the full adult period is reached. In the old, the process of separation is oftentimes very slow, on account probably of the feeble circulation. The superficial necroses are more quickly separated than the central and total necroses. The total

necrosis of acute diffuse periostitis is an exception to this rule; if the whole shaft up to the epiphysial line has died, it will be very quickly loosened from its connections. The periosteum has already been stripped from the bone, and the cartilaginous epiphysial line is easily disconnected from the shaft. The rapidity with which a necrosed portion of bone will separate, depends also on the particular bone affected. Those of the upper extremity are more rapidly loosened than those of the lower, probably on account of their greater vascularity. In the young adult, two to three months will probably be about the average length of time for the bone to become loose in the lower extremities, whilst in the upper, the average would be about six weeks to two months. When thoroughly loose, the probe on striking the dead bone often produces a hollow note. Two probes may also be introduced into two different sinuses, and by alternate pressure a movement of the sequestrum may be effected; or, in case of exfoliation, a director may often be introduced beneath the edge of the sequestrum, which is then tilted up and felt or seen to move.

The *prognosis* must necessarily vary very greatly according to the extent of the necrosis, the bone that is affected, the proximity of the disease to a joint, and the constitution of the patient. We have also to bear in mind that, in old and long standing cases, amyloid disease of the viscera is liable to ensue, as it does in caries.

Treatment.—Free incision for the evacuation of pus is the first and most important consideration. Dependent openings should be made wherever it seems likely that pus would have a tendency to gravitate. Absolute rest should be obtained either by a splint or pillow. Antiseptics should be so far carried out as to prevent decomposition and putrefaction of the discharge, but, in the writer's opinion, it is not necessary to employ the rigid Listerian method throughout the prolonged treatment of such cases as these. When the abscess is first opened, especially in chronic cases (e.g. syphilitic), it may be wise to do so in the hope that necrosis may not ensue. In acute diffuse periostitis it will be found, however, a vain hope. Putrefactive bacteria are already present in the pus before it is evacuated, and necrosis to a greater or lesser extent invariably ensues. The exceptions to this rule are so rare as to be beyond the scope of this article. Such material as the salicylic, iodoform, or wood wool, firmly applied with a bandage and

changed once a day, is generally sufficient. It absorbs the discharge and prevents it from decomposing. This also enables the surgeon to see, at the earliest possible moment, when a still more effective opening may be made for the evacuation of pus.

When the time comes for the removal of sequestra, to which allusion has already been made, ether will have to be administered and possibly a tedious operation undertaken. In most cases Esmarch's bandage will be found of great assistance, enabling the operator to see clearly when he has removed all the dead bone. The cloacæ being enlarged or thrown into one another by the chisel, gouge, or one of the various forms of cutting bone-forceps, the sequestrum is seized by a pair of large necrosis-forceps and extracted. If there is any difficulty, such as may arise from both ends of the sequestrum being still under cover of its ensheathing bone, it may be divided into two parts and then easily removed. Of course, a small sequestrum can often be removed with only a slight enlargement of the sinus, and the application of a small pair of dressing-forceps or a director. In the case of an exfoliation there is still less trouble, as it only requires lifting from its bed.

As regards general treatment, the patient may require considerable care and attention, especially in the case of acute diffuse periostitis, to keep his powers in a fit condition to cope with a prolonged and exhausting disease. Good, wholesome nourishment should be frequently given, wine or brandy being added according to the particular case in hand. The more a patient can take and assimilate, the better chance he seems to have of living through such an illness as that produced by a severe necrosis.

H. H. CLUTTON.

NEEDLES.—The suture-needles in common use are either straight, 'semi-curved'—i.e. curved towards the point—or full-curved, i.e. curved along their entire length. The straight needles are the easiest to introduce, and are the best for stitching together large surfaces, such as amputation-flaps; the curved needles are not so easy to use, but are very serviceable in regions which are depressed below the surrounding parts, such as the angles of the eye, or in cavities, such as the vagina. The 'full-curved' needles should be held between the forefinger and thumb, and introduced by a movement of supination; a needle-holder is a great assistance when very small curved needles are employed. For carrying

silk, catgut, or horsehair, an eye like that of an ordinary sewing-needle answers very well; but it does not do for wire, as the loop of the latter is too bulky, and is liable to slip from its place and check the passage of the needle. To meet this difficulty several special needles have been invented. In one the wire is screwed into a female screw at the end of the needle; in Lister's needle the eye is placed laterally, and is deeply grooved so as to carry the wire. Price's needle has two eyes, placed one in front of the other, and is deeply grooved: to thread it, pass the wire from before backwards through the posterior eye, next in the opposite direction through the anterior one, and, finally, turn the end of it sharply backwards into the groove on the anterior surface of the needle. Murray's needle contains in the blunt end a conical canal, the larger end of which opens in a groove on the side, and the smaller at the heel of the needle; the wire is passed in at the heel of the needle, and projected at the side of it; the tip of the wire is then turned down and pulled back till it is jammed in the conical canal. Ward-Cousins has introduced, or re-introduced, a needle and wire all in one piece.

Tubular needles are also used for passing wire sutures, and Startin had them so made that, whilst capable of being used separately, the two together form part of an ellipse, and when passed from opposite sides of the wound one fits into the other; a complete tube is thus formed, through which the wire may be passed, so that, on removal of the needles, the wire will remain *in situ*. The tubular needle is very useful for passing wire sutures in the operations for cleft-palate and vesico-vaginal fistula. For the former operation T. Smith has invented an instrument, which consists of a tubular needle at the extremity of a long handle, to which a reel is attached to hold the wire, and a wheel to project it through the tubular needle. A very similar instrument was described by P. C. Price in 1860. Spencer Wells has devised a needle with an 'opening eye,' so that a loop of thread may be removed from it without being cut; it is of special value where the quilled suture is used. Spencer Wells has also devised a needle with a notch near the point, for use in operating for vesico-vaginal fistula; the suture is passed through one side of the fistula with a *nævus*-needle, and the notched needle passed through the other side; the loop of the suture is then caught by the notch, and, as the needles are withdrawn, the suture is left in position.

The name, '*nævus* needle,' is applied to a sharp-pointed needle on a handle, which has the eye near the point; and '*aneurism* needle' to one which differs from the last-named in being more curved and blunt-pointed.

HAGEDORN'S NEEDLES are flattened laterally, and are of equal width and thickness from the eye to the point. They have a cutting edge, which resembles a Beer's cataract-knife, on the convex border of the needle near the point. The eye is placed laterally, as in Lister's needle for wire sutures, but it is not grooved. The advantages of these needles will be evident, if the wounds they make be compared with those made by the curved needles in common use. The latter, being flattened transversely to the curve, make an incision parallel with the direction of the wound, so that when the suture is tied the incision made by the needle is pulled into a triangular wound, which does not always heal by first intention. Hagedorn's needle makes an incision at right angles to the direction of the wound, and consequently in the line of traction of the suture, so that the latter will rather tend to approximate its edges, and so interfere as little as possible with primary union of the needle-puncture. The greater strength of the needle which results from its being curved on the edge instead of on the flat, prevents its being bent out of the desired course when it penetrates indurated tissues, and the direction of the wound which it makes involves less damage to nerves and tendons in suturing operations.

Hagedorn's needle for suturing intestines has a rounded point instead of the cutting edge described above.

BILTON POLLARD.

NEPHRALGIA, or pain in the kidney, may be produced by a variety of causes, and it appears likely that the list of these will, as the result of further study, be extended far beyond its present limits.

The most common cause of nephralgia is the presence of calculus in some part of the kidney. We are not yet in possession of sufficient facts to enable us to indicate exactly the situation of the stone, nor are we able from the character of the pain alone to estimate its size. It may be said generally, however, that where the nephralgia is paroxysmal, the stone is more likely to be in the pelvis of the organ and more or less movable, and *vice versa*. The pain is usually dull and aching, and referred to the situation of the kidney; but it may be

sharp and spasmodic, and radiate down the side into the testicles, or to the tip of the penis. It is increased as a rule by pressure over the kidney, and usually also on movement of the body, and is sometimes severe enough to produce nausea, or even vomiting. This is especially likely to take place where a stone is lodged in the commencement of the ureter, and is being forced into the latter, giving rise to bleeding and, probably, plugging by clot. The whole assemblage of symptoms associated with the passage of a stone or clot into the ureter is known as RENAL COLIC.

Nephralgia is also produced by new growths in the kidney, but, probably, not usually until they have either commenced to cause distension of the pelvis, blocking of the ureter by growth or blood-clot, or change of place of the kidney itself with more or less drag on the pedicle. This change of place must always occur where the organ is much enlarged from any cause; the increase of size finds no room above on account of the diaphragm, and can only take place downwards and inwards. Gravity also plays a part here, and it also appears not improbable that the muscular action of the ureter, under irritation, may actually drag somewhat upon the mass. Nephralgia is also produced by tubercular disease of the kidney, and in at least three ways—(a) by ulceration, (b) by the production of blood-clots and consequent block of the ureter, and (c) by impaction of tubercular shreds in the latter. Of course, blood-clot due to injury of the kidney from any cause will also produce renal pain, either continuous or paroxysmal. Again, shrinking of the whole organ after interstitial nephritis may produce a neuralgic condition, and cystic dilatation has been known to produce the same thing. Cases are on record where, on exposure and removal of a kidney on account of severe pain and the suspicion of stone, nothing has been found but a small shrunken organ. Slight pyelitis, too, may cause pain, either as the result of the inflammation alone, or by producing more or less blocking of the ureter by a swollen mucous membrane. Then again, nephralgia often accompanies a movable kidney, and probably is due here to the dragging on the nerves of the pedicle, produced by the change of position of the organ. Finally, there are cases in which patients have suffered severe pain for years in the kidney and yet, after death, nothing has been found in the organ to account for it, the cause remaining as obscure as in the case of many other neuralgias.

The *treatment* of nephralgia will, of course, vary very much in different cases, since it is but a symptom of a variety of different conditions. Where, for reasons given in discussing the various objectively morbid conditions of the kidney, no local treatment of the organ is possible, we shall best deal with the nephralgia by enjoining perfect rest in the recumbent position. Next to this, warm applications to the flank will be most suitable. After these measures have failed, we have little left but the usual anodynes.

A. E. BARKER.

NEPHRECTOMY, or the removal of the whole kidney, is a measure unknown as a formal operation until the last few years. Any detailed history of the operation would be out of place here, and it need only be said that it was first performed on the human subject, as a definitely planned procedure, by G. Simon of Heidelberg on August 2, 1869, he having previously shown by experiments on dogs that it was feasible and physiologically safe. Before Simon's case the kidney had been removed, on a mistaken diagnosis, twice completely in America, and once incompletely in Germany; but the first impetus to the study of the whole question of nephrectomy, as a definite surgical procedure, dates from the publication of Simon's successful case and of his numerous experiments, in 1871. In this country the operation was first done by Dr. Meadows in 1871, under the impression that the tumour dealt with was an ovarian cyst; then by Mr. Durham, rather as an exploratory measure for a painful tumour of the flank. The first British surgeon to perform nephrectomy designedly appears to have been Mr. Jessop of Leeds, whose patient, a child of two and a half years of age, from whom he removed the kidney for encephaloid disease in January, 1877, recovered and lived several months afterwards. Within the last few years, the kidney has been frequently excised for various morbid conditions, in England and elsewhere, and the knowledge of the condition requiring this treatment, and of the details of the operation, has increased rapidly with the publication of every case, unsuccessful as well as successful. But in spite of the long array of nephrectomies now before us, much difficulty remains in deciding as to the choice of cases in which this procedure should be adopted, and the exact method to be followed. Nephrectomy has been performed now for renal neoplasms, for calculus, for pyo- and hydro-nephrosis, tubercular kidney, injury to

and rupture of the organ, and for floating and painful kidney, and the reader is referred, for the consideration of these conditions, to the special heading of each. The question remaining for us now is the method of procedure, and here there is still much difference of opinion, which must last for a considerable time to come. There are, however, some general conclusions which may be considered as fairly established, and these will be alluded to when the various methods have been described.

There are three points in the abdominal walls at which the kidney may be removed—(1) in the loin, at the outer border of the erector spinæ muscle; (2) at the outer border of the rectus abdominis muscle; (3) in the linea alba. The chief advantages of the first of these methods are that the peritoneal cavity is not opened, that no important structure is wounded in reaching the kidney, and that the wound can be freely drained, from behind, without much risk of infecting the peritoneum. The main advantages in opening the abdomen at the outer border of the rectus (Langenbuch's incision) are, first, that the kidney and its pedicle are here most easily reached, and this not through the anterior layer of the meso-colon, which contains large veins, but through the posterior or external layer, which has very few vessels; secondly, the operation wound in the perinephral tissues can be made practically extra-peritoneal, by stitching the outer layer of the meso-colon to the anterior lip of the incision in the abdominal wall early in the operation, and so shutting off the general cavity of the abdomen from that left behind by the removal of kidney, which can now be freely drained. The strongest reasons for choosing the third method of removal—i.e. by median abdominal section—are found in the fact that freer access is thus gained, not only for the removal of larger renal tumours and ligature of their pedicles, but also that the state of the opposite kidney can by this means be ascertained, by passing the hand across the abdomen, and actually feeling the organ with the fingers. It is necessary, however, to mention that though the hand may reach the kidney opposite to the one it is proposed to excise, its soundness or the reverse cannot be ascertained by mere palpation. Great enlargement, or, on the other hand, great reduction, in size or complete absence might be detected; but the organ might be tubercular, or fibroid, or contain a moderate-sized calculus, and yet the hand be unable to detect the condition. This

plea for the median incision cannot, therefore, be allowed to have much weight.

The chief objections raised to the first or lumbar method are, that the organ is more difficult to reach from behind, especially its pedicle; also, that the space between the last rib and the iliac crest is too limited for the removal of large tumours; finally, that the condition of the opposite kidney cannot be ascertained by direct examination. The drawbacks to the second or lateral incision are that the peritoneal cavity is opened, and also that if the tumour cannot be removed without the escape of some of its contents, it is not so easy to drain, without contamination of the peritoneum, as in the first method. Also, that if there be any oozing of blood, it is likely to find its way into the cavity of the abdomen, both during and after the operation. The liability to hernia at the seat of incision appears to be greater here than at the more posterior wound. The same reason may be urged more strongly against the median method, where the difficulty of keeping the peritoneal cavity clean is still greater under all conditions. Besides this the intestines may be much in the way, and give rise to great trouble by protruding from the wound. Further, the anterior layer of the meso-colon must be divided to reach the kidney, and here there is much risk of bleeding, from the large size of the veins running through it.

A careful review of all the arguments, for and against these several procedures, and their results, justifies the conclusion that each has its proper place in surgery, and that it remains for future experience to determine the exact conditions under which each should be adopted. For the present, it may be said generally that, for the larger solid and non-inflammatory tumours (if these are to be operated on at all), abdominal section is to be preferred; while, for the fluid tumours of the kidney and inflammatory conditions, one of the lumbar incisions is best suited.

Something remains now to be said as to the details of each method of performing nephrectomy. First of all, in every case the strictest antiseptic precautions should be observed from beginning to end. The lumbar incision is the same as that in NEPHROTOMY, until the surface of the kidney is reached. The subsequent steps of the operation are determined by the condition of the organ. If its surface be quite unaffected by present or bygone inflammation, it is easily and rapidly separated by the finger from the surrounding

fat until the pedicle is reached. This is true, whether we are dealing with a healthy kidney, or one in which there is a stone, or a new growth, or a collection of cysts the result of obstruction. But, if the organ have become adherent by inflammation to the perinephral fat, itself condensed and shrunken so that it forms one firm tough investment intimately united with the capsule, it is best to enucleate the kidney out of the latter, leaving it behind with the condensed fat. Indeed, it is not possible to do otherwise in many cases, for the material surrounding the kidney is so tough that it can hardly be torn with the finger, and so vascular that, if at all roughly dealt with, it bleeds so freely as seriously to endanger the patient's life. This process of enucleation is rarely a difficult one, if the surface of the kidney is closely followed, no matter what the amount of condensation of the tissues around may be; but if this guide is lost, and the finger is carried into the surrounding tissues, the difficulties are enormously enhanced. These general rules will be found serviceable for this part of the operation, but beyond them each case must be treated on its own merits.

Having reached the pedicle, the vessels are ligatured in two bundles with stout carbolised silk, passed through the middle of the mass and tied over each half in succession, and then round both together. The ureter may be either simply divided or tied with the vessels, or by itself later, and may either be left in the wound or, perhaps better, be drawn to the surface and secured there in the angle of the skin incision, so that no regurgitation may take place into the wound. This might be a serious matter if the ureter were dilated and full of foul urine or pus, which, escaping into the wound, would render it septic.

After this, the organ may be removed by a few snips of a scissors as near the kidney as possible, or even leaving a little of its tissue if sound. This tissue will soon cease to secrete and become fibrous, when the renal vessels are once tied. The ligatures, in some cases, have to be applied while the kidney is *in situ*; in others, the organ can be lifted out of the wound beforehand. But, in whatever way the act is performed, every care should be taken to avoid dragging upon the pedicle, whether in passing the aneurism needle through it, or later in manipulating the organ, every such strain adding materially to the shock of the operation. The writer has endeavoured to ascertain the effect upon the circulation of ligation of the pedicle in several cases in which

he has performed nephrectomy, by having the pulse carefully watched throughout, and in the last case by having a sphygmographic tracing of the pulse made while the operation was proceeding. He has found that the pulse is not very much affected to the touch, but the tracing showed some irregularity during the process of manipulation of the organ, followed by increased arterial tension when the pedicle was ligatured. These observations, however, will require to be repeated frequently before we shall be able to pronounce positively upon this point. The ligatures should be cut short in aseptic cases, but, where there is suppuration, it is better to leave them long and carry them out of the parietal incision, and wait for their coming away in the usual manner. This they will not do in a perfectly aseptic wound, but become encapsuled, giving no further trouble. As to the relative merits of catgut and silk, this is not the place to discuss them. It may be remarked, however, that most surgeons prefer silk for this part of the operation.

After division of the pedicle, it only remains to insert a drainage-tube (which should be large and long), and to close the external wound with a few wire or silk sutures, all blood-clots having first been removed from the perinephral space. An antiseptic dressing is then applied over all. It is well in these operations to remember the occasional presence of aberrant renal arteries, entering as they may any point of the concave surface of the kidney. They may be met with at any stage of the operation, and, if great care is not observed, may be torn across, and should always be looked for and secured as early as possible.

Nephrectomy by lateral abdominal section (Langenbuch's) is thus performed:—The patient lying upon the back, an incision about four inches long is made at the outer border of the rectus muscle through the tendinous tissue of the linea semilunaris. Any slight bleeding having been stopped, the peritoneum is opened, some part of the colon presenting most probably in the wound. This is gently pushed inwards, on which the external or posterior layer of the meso-colon is exposed. In this there are no vessels of importance, and the incision through the peritoneal layer may be made in almost any direction suitable for the removal of the kidney, but a vertical line is to be preferred. If the tumour to be removed contain fluid, whether urine, pus, or blood, it may now be wise to unite the anterior lips of both peritoneal wounds—that of the abdominal wall and that of the meso-colon

—closely together by catgut sutures, so as to shut off the general cavity of the abdomen from the perinephral space about to be freely intruded upon. By this measure, if the fluid in the tumour should burst its covering, it is prevented from contaminating the whole abdomen, and can flow freely out of the parietal wound. If this is done, moreover, a drainage-tube may be inserted through the front abdominal wound into the post-peritoneal space, after removal of the kidney. In other respects the rest of the operation is performed exactly as that in the median line described below. Access to the kidney and pedicle is much easier in this lateral operation than in either of the others; but an examination of the opposite kidney is not so easy as with a median incision.

In nephrectomy by median abdominal section, the steps of the operation up to the actual enucleation of the organ are almost the same, generally, as in OVARIOTOMY. The division of the abdominal muscles and peritoneum, and the precautions to be observed throughout as to bleeding, treatment of the intestines, &c., are alike in both procedures. But when the bowels have been drawn aside and the anterior layer of the meso-colon has been reached, the special difficulties of the nephrectomy commence. First of all, a transverse incision is made in the anterior layer of the meso-colon, great care being taken to avoid wounding the large veins, which run usually transversely across the diseased organ. If necessary, these should be secured by double ligatures and divided, which is better than running any risk of their being torn in enlarging the opening or getting out the kidney. Then, the organ is separated from its surroundings by the finger swept either outside or inside the capsule, according to the amount of destruction of fat by inflammatory sclerosis, or the absence of this process (*see above*). Sometimes this process of enucleation is very easy, and accompanied by but little bleeding, as in the case of renal new-growths of moderate size; sometimes it is extremely difficult, especially where inflammation has existed for a long time in the kidney. When the pedicle has been reached, the organ can be lifted out of the abdominal wound and the vessels and ureter secured, as in the lumbar operation (*see above*). Then the organ is removed with the scissors, and the pedicle is allowed to slip back into the post-peritoneal space left by the enucleation. Nothing now remains to be done but to clean out all blood-clots from this space, close the peri-

toneal wound over it with catgut stitches, carefully cleanse the peritoneal cavity, and unite the edges of the abdominal wound with silk, as in ovariectomy, a gauze or salicylic-wool dressing completing the operation. If there be any indication of likelihood of effusion of blood or serum into the post-peritoneal space, a knife-blade may be thrust through the lumbar abdominal wall, from within, at the point of election (*see NEPHROTOMY*), and a drainage-tube inserted to drain this space, which is then shut off from the general cavity of the abdomen by suture of the edges of the peritoneal wound with catgut.

Any comparison of the results of these three methods of performing nephrectomy, and their relative mortality, has at present but little value as a guide in the choice of an operation. The diseases for which they have been employed are so various, and the stages of these affections at which nephrectomy has been performed so very different, that no reliable conclusions can be drawn from mere statistics. The author's attention to the whole subject has been very close for several years, and his personal experience of the operations considerable, yet, at the present moment he is unable to profess any decided leaning to one method more than another, speaking of the removal of the kidney generally. Perhaps there is a slight tendency amongst surgeons to prefer lumbar nephrectomy for the common affections. But the whole question can only be decided when we are able to group our cases more accurately, and have a far larger amount of material to judge from than at present.

ARTHUR E. BARKER.

NEPHRITIC COLIC. *See NEPHROLITHIASIS.*

NEPHRITIS, or inflammation of the kidney, is met with in a great variety of forms, from the mildest catarrh to the most destructive suppuration. In surgery we are not often concerned with it as a primary affection, but usually as secondary to some general or local condition. It is not proposed to do more here than give an outline sketch of the simpler forms, as they come under the notice of the surgeon.

Simple nephritis, as distinguished from pyelonephritis and pyelitis, may be either *acute*, *subacute*, or *chronic*. The *acute* form is met with after injuries to the kidney, exposure to cold, the use of over-stimulating diuretics, such as cantharides and turpentine, or too large doses of other irritants, such as the mineral acids, nitrate

of potash, and carbohc acid; it is also met with in various acute febrile states. Besides these exciting causes, may be mentioned one to which considerable attention has of late been directed. This is the reflex irritation of the kidney produced by operations on, or acute inflammations or injuries of, the lower urinary organs. The manner in which this irritation operates, in producing renal hyperæmia, is best explained by the theory of reflex vaso-motor disturbance. The violent stimulus to the nerves of the urethra, penis, or bladder, produces first a contraction of the renal capillaries, followed by great dilatation. The congestion thus arising may be, on the one hand, so slight as hardly to deserve the name of an inflammation, or, on the other, may be deep and persistent. In the first case we have a transient catarrh, in the latter a definite interstitial nephritis. The kidney in the last condition will be found more or less enlarged, darker than usual in colour, and on section engorged with arterial blood, and possibly dotted with small ecchymoses.

The *symptoms* here, whatever the nature of the exciting cause, will usually be the same. In the first place there will be dull aching pain in the affected kidney or kidneys, aggravated by either movement or pressure over the flank. There will also be fever, with malaise, headache, anorexia, and insomnia, sometimes nausea or even vomiting. The attack may have been ushered in by a rigor; the skin will probably be hot, flushed, and dry; the mind is not usually affected. The objective symptoms are found in the state of the urine. This is usually very scanty, or, if both kidneys are affected, there may even be temporary anuria; it is highly coloured or 'smoky,' acid, and loaded with lithates, and deposits a brownish sediment. This, under the microscope, will be found to consist of blood-corpuscles and blood-casts, of urates and renal epithelium. The fluid will probably be of low specific gravity and highly albuminous.

In the *subacute* form, there is only a difference of degree in all these phenomena.

The *treatment* of simple acute nephritis, apart from that of any condition which may have played a part in the production of the disease, is aimed at reducing the work thrown upon the kidneys, and diminishing their acute congestion. The first of these requirements is met by encouraging the skin to act by hot vapour or water baths, with the cautious administration of

diaphoretics and smart purgatives, and by the regulation of the diet, which should be very light, consisting chiefly of milk. The second is fulfilled by local blood-letting over the kidney in sthenic cases, or dry cupping in asthenic cases, followed by hot poultices, and by complete rest in bed and avoidance of exposure. Diuretics are to be avoided, and alcoholic stimulants used sparingly.

The *chronic* form of this disease has a special interest for us here, inasmuch as it is met with in many surgical affections to which it is secondary. Chronic interstitial nephritis may be produced, simply by the continued operation of many of the causes spoken of above, as agents in the acute disease. The most interesting of these, however, for the surgeon is prolonged irritation, either in the bladder or urethra. This irritation may be due to stone or stricture, to villous growth or chronic cystitis, and is capable of producing very profound changes in one or both kidneys. Taking a well-marked case of chronic interstitial nephritis as an example, we may expect to find the affected organ smaller than usual; its capsule does not peel off easily, or may actually adhere closely to the cortex, and leave a granular or broken surface on being separated forcibly. The cortex is more or less reduced in depth, and is granular, toughened, or even almost fibrous on section. The same may be said of the pyramidal portion; the calyces are pale. Under the microscope we see all the evidence of interstitial hyperplasia, with more or less atrophy of the secreting substance.

The *symptoms* of chronic interstitial nephritis are not very distinctive in all cases; still there are some which assist us much if taken with other evidence, and especially the past history of the case. First, the character of the pulse aids us. It is hard and incompressible, and gives the tracing of high arterial tension with the sphygmograph. The muscular vigour and general strength of the patient will be probably much lowered. The urine is usually pale and of lower specific gravity than normal; it is deficient in urea, and often contains albumen and a few casts. In amount it may be normal, but it will probably be somewhat below the average standard.

The *treatment* of chronic interstitial nephritis is general rather than local. The avoidance of rapid alternations of temperature stands first; then, the maintenance of an equable action of the skin by warm clothing, baths, and frictions, and the regu-

lation of the bowels by purgatives. The diet should also be carefully attended to, and all articles tending to over-stimulate or throw much strain on the eliminatory functions of the kidney must be avoided. Every source of irritation in the urinary tract should be removed if possible, but it must be remembered that the use of instruments to this end should be as far as practicable avoided; the passage of catheters, for instance, or operations on the urethra or bladder, being very badly borne in many cases where this condition is present. Indeed, chronic interstitial nephritis is chiefly interesting to the surgeon as one of the barriers to operation on the lower urinary organs. Where any source of chronic irritation has been long present in the urinary tract, it should always be looked for; and any evidence of its presence should be carefully sifted before such an operation is decided on.

ARTHUR E. BARKER.

NEPHROLITHIASIS, or the presence of calculous matter within the kidney, is a very common condition. Owing to some fault in digestion (using the term in its widest sense), or, on the other hand, to some deficiency of energy in the kidney, the amount of organic matter, thrown upon the latter for elimination, exceeds its powers of excretion in solution at some particular time, and a certain quantity is deposited in a crystalline or sub-crystalline form in the organ. It appears probable, however, that without some local morbid condition—e.g. a catarrhal state of the lining of the tubules, pelvis, or calyces—such a deposit will not take place, no matter how concentrated the urine, and many arguments are adduced in support of this view.

The exact point of origin of the earliest traces of renal calculi it is not easy to determine; but it appears probable, from the most recent observations, that they begin to be formed in the renal epithelium. Impaired energy in the cells of the latter, whether it be due to over-exertion and consequent exhaustion, or decay from age, may lead to the accumulation in them of one or other of the crystalline matters met with in calculi. Be this as it may, small concretions are frequently found in the straight tubules, and projecting from the pyramids. These, which are formed of crystals, altered by their suspension in an albuminous medium, are the centres around which the larger stones are formed. According to the condition of the urine in which they eventually sojourn, they will receive

laminated deposits of one or other of the calculous materials. Those most frequently met with in the kidney are—uric acid, oxalate of lime, and phosphate of lime. In the majority of cases, the small concretions pass rapidly into the ureter and bladder, giving rise to no further renal derangement; but, in other cases, the crystals are retained in the tubes or calyces, attached to some roughened spot, and there become aggregated, so forming by gradual accretion the smaller or larger stones with which we are familiar. These are met with at all ages, and in both sexes with about equal frequency. Carbonate of lime calculi have also been found in the kidney, but are very rare. All parts of the organ may be the seat of these concretions, but the urate and oxalate calculi are more likely to be found in its substance than the phosphate and carbonate of lime, which are met with in the pelvis. Calculi of the kidney are mostly irregular in shape, but the greatest irregularity is seen in those lying in the pelvis, where they often form large, branching, tree-like accretions. Where phosphate of lime is deposited, it sometimes forms simply a thin coating over the pelvis of the kidney, without any actual definite calculus. Such a deposit clings closely to the mucous membrane on which it lies, and may be very extensive, or only cover one or more small patches. All renal concretions may be single or multiple, but are more commonly single.

Calculi in the kidney may give rise, on the one hand, to little or no trouble throughout a long lifetime, or to the most intolerable suffering or even rapidly fatal disease. They claim our attention on account of—(1) pain; (2) **HÆMATURIA**; (3) obstruction of the ureter and **HYDRONEPHROSIS**; (4) suppuration due to their presence, with or without **PRO-NEPHROSIS**.

The evidence of the presence of calculi in the kidney is based, in the first place, upon the family and personal history of the patient, and then upon certain subjective and objective symptoms. In many cases, there is a history of the uric acid diathesis in the patient's family for one or two generations, and in his own case, perhaps, for a long time anterior to the date of his present ailment. He may have lived, too, for a longer or shorter time in a 'stone country' himself. He will often give the history of having habitually passed highly acid urine, depositing lateritious sediment on cooling, or may even have voided small calculi from time to time, with or without what is known as **RENAL COLIC**. The symptoms will de-

pend, not so much upon the size and shape of the stone, as upon its situation and the condition of the kidney in which it lies. For it is well known that a large and irregular mass may lie for years within the kidney without giving rise to much trouble, while a small, comparatively smooth, calculus may be a most troublesome inmate of the organ.

Taking the simple cases of nephrolithiasis first, in which there is little or no structural alteration in the kidney, we have to consider certain symptoms, *subjective* and *objective*. Among the former pain stands foremost. This is either local or radiated, or both. When local, it is usually described as constant, dull, aching, or gnawing, but it may be pricking or lancinating. It is subject to exacerbations, often without any assignable cause, but is generally much aggravated by movement, and sometimes to such an extent as to render the patient bedridden. In such cases, the pain can often be traced to the blocking of the ureter by a blood-clot, produced by the movements of the calculus in the pelvis of the kidney. The radiated pain is usually described as localised about the neck of the bladder, or running down towards the groin in front of the thigh, and into the testicle or penis; it has even been observed as low as the foot. Tenderness on palpation over the kidney is another symptom often prominent, but it may be conspicuously absent. Nausea is also occasionally noticed, and that not only on the passage of a stone down the ureter, but also from its presence in the pelvis of the organ. It is also often felt as the result of a blood-clot, from irritation of the stone, stopping up the ureter and causing distension of the pelvis of the organ, or, again, where a clot passes down the ureter slowly.

The *objective symptoms* in simple non-suppurating cases are not many. Among the first comes hæmaturia, which may be very abundant, giving rise to bright red urine, or only cause a 'smokiness' of the secretion. In all cases, however, the blood is thoroughly mixed with the water. Next to this symptom comes frequency of micturition, which is often marked. Then, retraction of the testicle is noticed in a small proportion of cases. Finally, there may be a trace of catarrhal products in the urine, the latter remaining acid. This is a valuable symptom if disease of other parts of the urinary tract can be excluded, and when taken with other evidence.

In *suppurative* cases, or, where there is impaction of a calculus in the ureter, we find, of course, several additional objective

symptoms and a few subjective. Among the latter are rise of temperature, thirst, headache, and anorexia. The rise of temperature is often very regular at night, and may equal two or three degrees. The objective symptoms will be those of pyonephrosis or hydronephrosis, with more or less pus in the urine in the former case. But without either pyo- or hydronephrosis, the kidney may be enlarged by chronic inflammation so as to be felt easily by the hand; or, what is more common, the perinephral fat may be condensed or destroyed by inflammatory irritation due to the stone, and its place may be taken by a thick layer of fibrous tissue, which gives the impression, on handling, that the organ itself is enlarged. In such a case, the position of the organ will probably be somewhat altered, and we shall find it lower and more internal than usual. This is probably due in part to its increased weight, and possibly also to increased muscular contraction of the ureter under the stimulus of inflammation.

Treatment.—During the last few years the treatment of nephrolithiasis has undergone much change. The preventive treatment, in the first place, has improved with the increasing knowledge of the laws which govern digestion and excretion. But where a calculus has actually formed in the kidney, we are no longer satisfied with simply dealing with each symptom as it arises, be it pain, suppuration, or bleeding; but we aim, in suitable cases, at the removal of the directly offending cause—viz. the stone. It is necessary, however, to insist on the exclusion of cases unsuitable for operation. On the one hand, many individuals spend a long life almost or altogether free from pain, in whose kidneys considerable stones are found after death, and, on the other, we often find very small calculi giving rise to the most acute suffering and even danger. Again, facts are accumulating which show that most of the symptoms, ordinarily attributed to the presence of a stone in the kidney, may be present to a perfectly deceptive degree for years, and yet on operation, or after death, no trace of a foreign body be found in the organ or in the bladder. Three chief conditions, then, should be clearly present before the question of operation is entertained, even for a moment:—(1) That the symptoms should be as clear as possible; (2) that the patient's sufferings should be intolerable in spite of all treatment, or that there should appear to be danger from prolonged bleeding or suppuration; (3) that the disease should not have lasted so long as to have damaged the patient's general

health so far as to render the operation a desperate one, and, above all, so long as to risk the functions of the opposite kidney.

If these conditions be fulfilled, we have a choice of three operations—of NEPHROLITHOTOMY, NEPHROTOMY, and NEPHRECTOMY. But in simple cases of nephrolithiasis, in which there is clear evidence of the presence of a calculus and little or none of further morbid conditions about the organ, but where the sufferings are severe, we now almost entirely limit ourselves to the first of these procedures. For it has been abundantly shown, already, that it is quite possible to excise a calculus from an otherwise healthy kidney, with little or no risk to the patient, and with no special damage to the organ. If this be so, nephrolithotomy, and it alone, is the proper operation wherever possible. There are, however, as already stated, cases where all the subjective and objective symptoms point to the presence of a calculus, and yet where none can be found on reaching, handling, and puncturing the organ. Here it is in some cases right to incise the kidney at once, and search the pelvis and calyces for a foreign body, and, if the symptoms have been very severe, to proceed to nephrectomy, even though none be found. The latter operation, however, will doubtless become much rarer as our powers of examination and diagnosis become more developed.

The general treatment of nephrolithiasis, short of operation, will embrace careful attention to diet, the use of baths, and friction of the skin in order to promote its healthy action, and the regulation of the bowels. The liver should be particularly attended to, the mineral waters of Friedrichshall and Rubinat being used with much benefit. Warm clothing and regular exercise should also be enjoined.

Prognosis.—Lithiasis of one kidney does not appear to shorten life. A patient may develop small calculi in the kidney, and continue to pass them by the ureter for years, without any decided impairment of health. It is only when the foreign matter is retained in the organ from any cause, and begins to produce secondary changes there, or the retention of secretion or of pus, that it becomes really dangerous. And even when both kidneys produce calculi which do not lodge in them, they may for a long time, if not indefinitely, remain adequate for all the wants of the system. But when calculi commence to be retained on both sides, they indicate a vice which will probably lead to grave complications before long. There appears, however, to be no

very decided tendency for calculi to appear on both sides at the same time; they are frequently unilateral. ARTHUR E. BARKER.

NEPHRO-LITHOTOMY, or the removal of a stone from a kidney not sensibly enlarged and with no evidence of accumulation of pus, is one of the most recent achievements of modern surgery. With the improvements in diagnosis of renal disease, we have learned to recognise, in many cases, the presence of a calculus, either in the pelvis or substance of the organ, *before this has been followed by suppurative irritation*. If, under these circumstances, the foreign body be removed, there is an immense gain to the patient. The dangers of suppurative pyelitis are prevented, suffering is relieved, and the organ, often comparatively healthy, is preserved to the economy. This operation was first performed on definite principles by Mr. Morris in February, 1880, and since then has often been repeated, with equal success, by other surgeons.

It is necessary to insist on the difference between this procedure and that of ordinary nephrotomy or incision into a suppurating kidney. This is quite distinct as to principle, aim, and prognosis. To incise the loin, and subsequently a sound organ, in order to remove a foreign body whose presence is causing certain subjective symptoms only, is totally different from cutting into the perinephral tissues in a state of inflammation, and opening up the kidney itself in order to give exit, not only to the calculus, but also to the products of inflammation, the result of its prolonged sojourn in the organ. And the prognosis of the two operations is quite different. In the first instance, though it may be more difficult to find the stone, the incision, being made in comparatively healthy tissue, heals readily in many cases; in the second, a freely suppurating cavity having been opened through more or less diseased tissues, many risks are run connected with septic infection, and a fistula in the loin is almost invariably left, a condition by no means devoid of danger, and giving rise, in all cases, to much discomfort. Both operations have their place, and their own special advantages; but they must always be kept apart, as essentially different.

The procedure itself is not difficult, but there are still great obstacles to its general employment. On the one hand, all the symptoms of stone in the kidney may be present, and yet, on reaching the organ by incision through the soft parts, no evidence of its presence may be detected, either by

the most careful palpation on all its aspects, or by acupuncture to the fullest extent, although the stone is actually in the organ. On the other hand, there are conditions beside renal calculus, producing symptoms which, for the present at all events, we are unable to distinguish from those of undoubted nephrolithiasis. *See* NEPHRALGIA. Both these facts have been established by operations on the living, and by observation, during life, of cases which have afterwards become the subjects of post-mortem examination. It is fortunate, however, that the same experience has also established the fact that exploration of the kidney by direct palpation, acupuncture, and even incision into its substance, is a procedure attended with very little risk if every precaution against septic infection be observed.

The operation itself is essentially the same as that of NEPHROTOMY, except that the point of incision into the kidney is determined by the situation and size of the stone; also, perhaps, there may be more difficulty in reaching the unenlarged organ behind the ribs, than in those cases for which nephrotomy is usually performed, where the kidney is mostly increased in size and has descended somewhat in the abdomen. But, on the other hand, there may here be less difficulty in examining the surface of the organ, on account of the absence of perinephral irritation, with consequent destruction or induration of the fatty and areolar tissue surrounding its capsule. In some cases in which nephrolithotomy is performed, the wound in the kidney remains open for a long time, giving rise to urinary fistula in the loin; in other cases it heals up rapidly and finally, any discharge from the interior of the organ finding its way down the ureter, and this often for a long time after the lumbar wound has quite closed.

The *prognosis* after this operation is very favourable. Up to the present all the cases of true nephro-lithotomy recorded have proved successful. It is important, as already stated, to remember this, and to distinguish between these results and those of nephrotomy and nephrectomy for more advanced disease. Many lives will be saved and much suffering averted by recognising this immunity from risk of nephro-lithotomy; and the necessity for early diagnosis of renal calculus and treatment by this operation, before such structural changes have taken place in the kidney as to render one or other of the more severe measures necessary.

ARTHUR E. BARKER.

NEPHRORAPHY, or the stitching of the kidney to the posterior abdominal wall, in cases of mobility of the organ, accompanied by severe symptoms, is an operation performed many times of late years with considerable benefit, but not often enough as yet to enable us to form a definite judgment upon its proper position as a surgical procedure. Up to the present time, however, it has been shown to be without risk, and the only point which can be urged against its performance is, that it is not always followed by permanent fixation of the organ and complete relief of suffering. The operation is only suited to those cases of movable kidney in which there is no mesonephron. *See* MOVABLE KIDNEY. Should the latter be present, it would be impossible to perform nephroraphy without injuring the peritoneum; but where the kidney simply slips about in the loose perinephral fat there is little danger of this, and the organ can be reached easily.

The operation consists in cutting down upon the kidney by one of the usual incisions for reaching the organ in the loin (*see* NEPHROTOMY); then the fatty capsule is drawn into the wound and stitched with eight or ten catgut sutures to its deeper edges. Besides these stitches, one or two are passed through the abdominal wall in front of the incision, and then through the cortex and proper fibrous capsule of the organ, which is pushed backwards by an assistant, to return through the abdominal wall behind the incision. These last sutures are fastened with buttons, and draw the kidney itself backwards towards the wound. A large drainage-tube having been inserted, the wound is closed with a few silk or catgut sutures. Very little bleeding ought to take place at any part of the operation, but some is seen on piercing the cortex of the kidney. This soon ceases, and if the wound be treated, as it should of course be, on the strictest antiseptic principles, the blood will have no ill-effect on the wound.

The drainage-tube may be left for a week or ten days, and the small amount of irritation necessarily produced will probably increase the firmness of the adhesions between the kidney and abdominal wall behind. The after-treatment consists in keeping the patient in the recumbent position for a considerable time after the operation, in order that the weight of the kidney may not stretch the new adhesions. The bowels should also be regulated. Subsequently, when the patient gets up, an abdominal belt should be worn, furnished with a pad, pressing gently, but firmly, over the renal

region in front. But, even with this, the patient should avoid all but the gentlest exercise for a long time after the operation.

It appears probable that we shall hear more of this procedure in the future, as it seems to offer many advantages over other modes of treatment in suitable cases, and to involve little risk. Writing in June, 1883, Dr. Newman says he had collected eight cases in which this operation was performed, and among these there were no deaths: at least five were cured of their troubles, the other three were too short a time under observation to judge of its effects.

ARTHUR E. BARKER.

NEPHROTOMY, or simple incision into some part of the kidney, is performed for a variety of conditions, chief among which are calculous or tuberculous pyelitis, pyo- and hydronephrosis. It is an operation of some antiquity, but, amongst the older surgeons, was performed only when the collections in the kidney or its pelvis had made their way very close to the surface, and were about to burst externally. Recently, the operation has been revived and developed, and is now performed at a much earlier stage of disease than formerly. Thus done, and with all the improvements of antiseptic surgery, nephrotomy is a measure attended with but little risk. It is now almost always performed at the same spot—viz. midway between the last rib and the crest of the ilium, and at the outer edge of the erector spinæ muscle. The incision through the skin and soft parts varies with the views of different operators. Sometimes it is vertical, along the outer border of the erector spinæ, for two or three inches; sometimes it is transverse, or obliquely downwards and forwards for the same length, or a combination of the vertical and oblique incision is adopted. But whatever line is chosen, the central point of each is practically the same for all ordinary conditions. Supposing the operation to be for calculus in the kidney, without much or any enlargement of the organ—a condition in which greater difficulties are met with than in others—the steps of the procedure are as follows.

The colon is carefully unloaded by enema. The patient is then placed on the opposite side, with a thick sand-bag under the flank, so as to make the side operated on as prominent as possible. The incision preferred by the writer is oblique, parallel to and a little below the last rib; it should sever the skin and superficial fat at once. The muscular layers are then divided, on

a director, until the posterior tendon of the transversalis muscle or fascia lumborum is reached. When this white structure is divided sufficiently, all the soft parts are held asunder with broad spatulæ, and then, the surrounding fat being carefully torn through with the finger or probe, the kidney is found embedded in it. In this dissection one or two arterial twigs may be cut, but are easily secured in the clip-forceps. The kidney may now be opened up in various ways, but is best incised longitudinally with a narrow-bladed scalpel, the organ being pushed toward the lumbar wound by the hand of an assistant pressed against the abdominal wall. When an opening has been made with the knife large enough to admit the finger, the wound may be enlarged by simple dilatation with the latter, or by the blades of a forceps thrust into it and expanded. This opening up of the organ will of course in many, if not all, cases be preceded by the other means of ascertaining its state, such as palpation, with the finger on both front and back aspects, and by acupuncture, and may be done boldly when we have by these means satisfied ourselves of the presence of a stone. But, even in those cases where the latter is not detected by these means, but there is still strong evidence of its presence from the subjective symptoms, &c., it will be proper to incise the pelvis from within outwards, and explore it well with the sound or finger. In such cases, too, the substance of the organ may be incised without much risk, if the cut be made steadily in either of the planes of the uriniferous tubules; but for calculus of the pelvis incision of the parenchyma is unnecessary.

There is, usually, smart bleeding when the cortex is cut into, but this will soon cease, as a rule, under pressure, either directly applied, as with a sponge, or indirectly, through the abdominal wall. If it prove too troublesome, the wound should be packed with antiseptic wool or a sponge wrung out of a strong antiseptic solution, the abdomen being firmly compressed with a bandage. In all cases, the incision in the abdominal wall should be carefully drained by a tube reaching quite down to the kidney, in some cases passing well into the organ. This tube will have to be kept in for a longer or shorter time, varying with the needs of the case. If it is one of hydro- or pyonephrosis the tube should be long, and provided with a rubber shield to prevent its slipping into the sac. The whole operation and the after-treatment of the case, whatever its nature, should of course be con-

ducted on strict antiseptic principles. Either silver or silk stitches may be used for the lumbar wound; the writer inclines to the use of the latter.

Prognosis.—It is impossible to give any reliable statistics showing the relative dangers of nephrotomy, the operation having been done for so many different conditions. But it may be fairly said that *per se* the procedure is not attended with any special dangers in most cases. Unfortunately the diseases for which it is performed are usually very advanced, and the operation is too often undertaken merely as a palliative, and if the patients succumb, the result is recorded against nephrotomy. Increased knowledge of the possibilities of renal surgery, and improved power of diagnosis will no doubt effect a reform here. Renal disease will be recognised much earlier than hitherto, and will be submitted to the surgeon, with confidence, at a stage in which the risks of operation are immeasurably less and the prospect of permanent benefit far greater. Eventually nephrotomy will probably become a rare operation, while nephro-lithotomy for disease at its earliest stage will proportionately increase in frequency.

ARTHUR E. BARKER.

NERVE-AVULSION. — Nerve-avulsion denotes the tearing out of the trunk of a nerve, as far as possible, from the bony foramen it passes through. This operation is resorted to as a last resource where previous NEUROTOMY or NERVE-STRETCHING has failed to give more than temporary relief in cases of severe neuralgia. The operation has almost invariably been performed on one or other of the branches of the trigeminal nerve, in the following way.

Operation.—The patient having been deeply anæsthetised, a vertical incision is made in the course of the nerve, and just over the bony foramen through which the trunk leaves the skull. The nerve is then freed from its peripheral attachments, is grasped in strong forceps—e.g. torsion-forceps, &c.—and wrenched out as far as possible. When the bone is left untouched, it will be found that the nerve almost invariably breaks off at the external orifice of the canal, the reason being that it is tightly fixed to the margin of the hole by very tough fibrous bands, which pass from the epineurium to the periosteum.

When the necessities of the case (e.g. return of the pain, &c.) demand that the rest of the nerve should be excised, the bony canal has to be opened up. In the case of the infra-orbital nerve this may be

done in two ways:—(1) The soft tissues filling the orbit may be detached along the lower border of the same and held up by Wagner's retractor, which is spoon-shaped; the nerve will then be seen running along the floor of the orbit, covered by a thin plate of bone and periosteum. The advantage of exposing it in this situation lies in the fact that the anterior dental branches are given off from the nerve while it remains in the canal; so that if the neuralgic pain is referred to the alveolar border of the jaw, it is obviously necessary to remove the whole nerve. (2) In very obstinate cases, it is advisable to remove not only the infra-orbital nerve but Meckel's ganglion also, as far as possible. This has been done by trephining the wall of the antrum and following the nerve back to the ganglion, which is then torn out. In this way the posterior dental branches are removed and, when thoroughly performed, anæsthesia of the palate obtained—a very important result, as the palate is frequently the starting point of the pain.

The inferior dental nerve is best reached at its peripheral extremity by depressing forcibly the angle of the mouth, while an incision is made parallel to the gum and just opposite the canine tooth, at the line of reflection of the mucous membrane from the jaw. The soft parts are then separated from the periosteum until the mental foramen is reached, and the fibres of the nerve felt issuing from it. The nerve-trunk should be exposed, and a loop of silk knotted on it. The outer margin of the foramen is next broken open with a sharp chisel and small bone-forceps, each blade of which is pyramidal in shape, so as to allow of either being inserted into the canal for the desired distance (usually an inch to an inch and a half), and the nerve is then lifted up by the ligature from its bed and removed as far as possible.

The nerve can be reached from inside the mouth also, where it enters the upper extremity of the dental foramen, the guide being the small bony spine on the lower margin of the same. The internal pterygoid is held aside with a retractor, while the nerve is freed for some little distance with a blunt instrument. It can also be reached, at the same point, by trephining through the ramus of the jaw and laying the nerve bare *in situ*.

The wound in all cases should be mopped out with strong carbolic acid solution (1-20), or chloride of zinc 40 gr. to f3j., then dusted with iodoform, and plugged with iodoform wool until granulations spring up from the

bottom, when it is to be frequently irrigated with weak Condy's fluid or sanitas.

The anæsthesia produced will gradually diminish to a very considerable extent, but the relief is always permanent where the cause is clearly shown to be neuritis. In all cases, deep **HYPODERMIC INJECTIONS** of ether, &c., should be attempted before operating. See **NEUROTOMY** and **NEURECTOMY**.
VICTOR HORSLEY.

NERVE-SECTION. See **NEUROTOMY**.

NERVE-STRETCHING.—By *nerve-stretching* is understood, either the bloodless operation of stretching the nerve-trunks in a limb by forcible extension of the distal joints, or the operation of laying bare a nerve, lifting it from its bed, and pulling it either in the direction of its course or at right angles to the same. Under the term nerve-stretching is also often included **NERVE-AVULSION**, an operation in which a nerve-trunk is completely torn out of its bed, as far as possible.

The following paragraphs relate only to nerve-stretching as defined above. The method of operation will be discussed first, next the anatomical changes and physiological effects it produces, while its value as a therapeutical agent will be given in conclusion.

1. The *bloodless operation* is performed thus: The patient being anæsthetised, the limb is first fully flexed at the proximal joint (e.g. the hip), the middle joint (e.g. the knee) is then slowly but firmly extended, and, when at the point of extreme extension, the distal joints are also extended. (Of course in this case the ankle will be forcibly 'flexed.') This state of tension is to be kept up for not less than from ten to fifteen minutes, and then the limb should be thoroughly shampooed, firm pressure being directed centrally, for another period of ten or fifteen minutes. The only point of risk to be mentioned is, obviously, the possibility of the vessels being diseased; and it is to be noted that the tension on a diseased popliteal artery is not much lessened by previously flexing the hip-joint.

2. The *cutting operation* is performed in the following way:—The patient being anæsthetised, a free incision is made in the direction of the nerve, and vertically over it. The superficial structures are divided to the same extent as the skin, and the muscles separated and held aside with retractors; the nerve will then be found lying beneath a layer of fat, and surrounded by a quantity of loose connective tissue, which forms

a 'false' sheath. This fatty tissue is now to be freely incised, until the epineurium or proper sheath of the whole nerve-trunk is exposed, contrasting by its shining white appearance with the surrounding yellow fatty tissue. The nerve should be freely isolated by knife and forceps, so as to admit of the forefinger being passed beneath it; if it is lying at the bottom of a deep wound, or if it is a small nerve, it should be gently lifted by a blunt hook until it can be grasped between the finger and thumb; care is to be taken that the hook is not used with force, otherwise many nerve-fibres will be damaged by the pressure of the instrument. See **NEUROTOMY**.

The nerve being firmly held between the finger and thumb, is then to be steadily pulled for about five minutes, first centrifugally, and then centripetally for a like period of time. The tension must be gradually applied and kept constant the whole time, while all jerks (the force of which is unknown) are to be avoided. The actual amount of force, with which it is advisable to pull, varies from a maximum of thirty pounds for the sciatic nerve to half a pound for the supra-trochlear. The amount of force must necessarily vary with individual development and the state of the nerve (Marshall). It will now be found that the nerve is loose and elongated, owing to its elasticity being relatively very imperfect.

The extension of the nerve is mainly produced by the nerve being drawn tightly along the length of the segment of the limb in which it lies, since in the ordinary position of a limb at rest, and even in the position of extension of one joint, the nerve-trunks are never taut, and when the limb is flexed they exhibit a wavy border, showing their complete relaxation.

The nerve is now replaced in the bottom of the wound; any bleeding vessel is to be ligatured, the wound perfectly dried, and the sides then brought together by a supporting silver suture or two, passed deeply through skin, fascia, and muscle, and crossing about half an inch in front of the relaxed nerve. The cut edges are then to be united with numerous catgut or horse-hair sutures, and a small drainage-tube inserted at the dependent end of the wound. The whole operation should be performed with strict antiseptic precautions, and healing obtained by the first intention; with this view, the drainage-tube in the largest wound (if perfectly aseptic) may be left out on the third day, and a large dry dressing with proper pads, &c. applied, and left on

for a week or ten days. Restriction of movement in the limb by a splint will be found practically very useful in ensuring rapid union of the wound; indeed, in cases of locomotor ataxy and other instances where the parts are deprived of the normal trophic influence of the central nervous system, this precaution must never be omitted.

3. *After-treatment.*—After the bloodless operation, the patient should be kept quiet in bed for a day or two, and then allowed to exercise the limb gradually, shampooing being performed daily. After the cutting operation, the same treatment should be adopted as soon as the wound is absolutely healed. This obviates the possibility of cicatricial bands fastening the cicatrix to the sheath of the nerve, a condition of things which is productive of considerable discomfort to the patient, by causing twinges of pain when the hip is flexed or firm pressure made in the neighbourhood of the scar.

4. *Effects of Nerve-stretching.*—(a) *Anatomical Changes, Macroscopic.*—It has been shown that when a nerve (e.g. the internal popliteal) is stretched by a weight below 10 lbs., the tension is thrown almost entirely on the fibrous sheaths of the nerve, viz., the loose epineurium binding the primitive bundles together, and the denser perineurium which ensheaths each primitive bundle. Also, all the nerve-fibres are straightened, and only altered, as described below, when the pressure reaches to more than two-thirds of the breaking strain. As a natural consequence of the tension the blood-vessels are compressed and emptied, while the lymph-spaces are absolutely obliterated and their contents driven out into the efferent trunks. It is very clear then, that if there is any inflammatory tension in the nerve, this must be got rid of by such a thorough compression of the vessels and connective tissues. (The 'bone-setters' in Turkey cure neuralgia of nerve-trunks by exerting very powerful and hard pressure along the course of the nerve, from the periphery towards the central end.)

Microscopic.—Harless and others have shown that the myelin sheath of the nerve-fibres exhibits transverse ruptures of every degree; while in cases where very severe tension has been employed, or at the point where a hook has been applied for the purpose of forcibly lifting a nerve from its bed, the myelin has been found to be broken up and aggregated in small droplets within the neurilemma. The axis-cylinder in some specimens appears attenuated and nodose,

but is very rarely injured. Provided the nerve is not torn across, regeneration always takes place.

(b) *Physiological Effects.*—These may be considered under two headings—(a) Effects on the conducting power of the nerve-fibres; (β) effects on the nerve itself, including the explanation of the beneficial effects of nerve-stretching in neuralgia, sciatica, &c.; (γ) effects on the central nervous system.

(a) *Effects on Conduction.*—A mixed nerve contains: (1) motor fibres; (2) sensory fibres; (3) vaso-dilator fibres; (4) fibres (possibly identical with 1) conveying trophic influences; (5) secretory fibres.

The effect of stretching a nerve gently is to heighten the conducting power of all these fibres, so that a limb, the main nerves of which are moderately stretched, exhibits slightly increased mobility, slight hyperæsthesia and marked increase of reflex excitability, increase in blood-supply and increase in nutrition, coupled with rise of temperature.

A stronger pull on the nerve will change this hypertonic into a hypotonic state, for then every function of the fibres, except that of movement, will be obviously diminished, and the first group of fibres to show this change is the sensory set, the result being diminution of reflex excitability, hyperæsthesia, and ultimately anaesthesia. A still more severe pull will affect the efferent conducting paths in the same way; thus, slight paresis up to paralysis may be produced, and at the same time trophic ulceration with loss of digits, and œdema of cellular tissues (most probably from vasomotor paralysis) may be seen. These profound trophic changes are not seen in man, owing to the fact that the amount of force required to produce them would be obviously unjustifiable. In fact, if the operation is performed for the relief of pain (e.g. in sciatica, tabes dorsalis, &c.), although half-measures are much worse than useless, still no paralysis beyond that of sensation, and that slight, should be produced in the part supplied by the nerve. The amount of force necessary to produce this may be put down as one-third of the breaking strain, as a rule. In every case, recovery of power of sensation, &c., will be obtained if the nerve is not divided, and if proper after-treatment is adopted.

(β) *Effects on the Nerve itself as an Organ.*—These are rather questions of anatomy, and have been discussed above, but one point of pathological interest has not been referred to, and may be mentioned here. It had been known for some time that

a person could accurately localise touch and pain in a nerve-trunk, and that the pain in neuralgia, sciatica, &c., was referred, as a rule, to the trunk of the nerve, which was found to be tender on physical examination, &c. Mr. Marshall assumed the existence of *nervi nervorum*, pressure on which from inflammatory exudation, &c., would explain the localised symptoms just described; and at the same time he showed that nerve-stretching would so damage these *nervi nervorum* as to diminish their conducting power. The writer has found that nerve-fibres and sensory nerve-endings are present in the sheaths of nerves, so that the anatomical basis of the above theory is supplied. It will be obvious that a very slight increase of vascularity, and consequent oedema, will cause very urgent symptoms by pressing on such nerve-endings enclosed within a firm sheath like the epineurium, and more especially in nerves (like the inferior dental, &c.) which lie in hard inextensible bony canals.

(γ) *Effects on the Central Nervous System.*—It still remains a question whether the extreme stretching of a nerve does produce any real effect on the spinal cord or base of the brain. It can very easily be shown, by exposing the spinal cord within a very short time of death, long before rigor mortis has set in, that, contrary to what has been frequently stated, there is no mechanical effect whatever produced on the nerve-centres by stretching peripheral nerves; the simple fact being that nerves are so fixed by fibrous bands in the bony foramina of the spine and skull, as to preclude the possibility of the least movement being transmitted. There then remains the possibility of the mechanical irritation of the nerve-fibres causing changes (functional) in the nerve-centres. Brown-Séquard and Quinquaud have asserted that, given anæsthesia by hemisection of the cord, this can be removed by nerve-stretching. This requires confirmation, as Prevost has obtained simply negative results in repeating the experiments. There certainly appears to have been produced, in guinea-pigs, a condition of greatly exaggerated irritability of the motor centres, leading to convulsions, &c., but very little can be argued from guinea-pigs direct to man, especially on this matter.

5. *Nerve-stretching as a Therapeutical Agent.*—It will be best, perhaps, to enumerate the different diseases in which nerves have been stretched with distinct advantage, and under each heading to mention the principal points which require special attention. It must be remembered that the estimates

given, of the percentage of cases in which relief was afforded, are necessarily rough and inaccurate, owing to (1) cases being published too early, and (2) cases of non-success being omitted from public records.

A. *For Abnormalities of Movement.*—

(a) *Spasms.*—Motor nerves have been stretched for spasmodic contractions of voluntary muscles with variable success, probably in about 50 per cent. of all cases. The cases should, however, be arranged in at least two groups—viz. spasms caused by old injury to nerve-trunks (Nussbaum's classical case is a good example), and spasms in which it is at present doubtful whether the irritative lesion is in the nerve-trunk or nerve-centres. As might be expected, the percentage of cures is very high in the first class and very low in the second. A common example of the second class is facial tic or *tic convulsif*, in which case, the facial muscles are affected with twitchings commencing insidiously. In these cases, the facial nerve has been exposed by an incision opposite the lower end of the parotid gland, and the nerve stretched on a small blunt hook. As a necessary result facial paralysis ensues, but as this clears up, the spasms tend to return, from which it would appear that the disease is usually of central origin. Putnam found that in a healthy dog eight pounds' pull was sufficient to paralyse; it is very probable that five pounds is adequate for the human being. He also makes the valuable and practical suggestion that, when nerve-stretching is undertaken for the relief of spasm, the patient should be preferably anæsthetised with ether, so that, if necessary, the effects of the anæsthetic may be got rid of during the operation, in order to see the effect of the latter on the affection. Reflex spasm, such as blepharospasm accompanying attacks of neuralgia, must of course be treated by stretching the afferent sensory nerve. See FACIAL SPASM.

(β) *Contracture.*—Wryneck (Billroth) and other instances of contracture in cases of peripheral lesion have yielded to nerve-stretching, but many cases have failed as soon as the conducting power of the nerve has been restored. In cases where the seat of the lesion is doubtful, nerve-stretching should be tried, as possibly productive of good.

(γ) *Tetanus.*—This condition has frequently been treated with nerve-stretching (45 times, Marshall, 1883), but with so small a proportion of successes (14), as to leave it perfectly open whether the good results were not simply cases of ordinary recovery by other means which were em-

ployed at the same time (e.g. Calabar bean, chloroform, &c.). Since we thus get information of very doubtful value from the records of empirical treatment, and since the pathology of tetanus is so obscure, nerve-stretching in this affection cannot be detailed at greater length here, but it may be worth while to mention that the successful cases appear to have been those in which the worst symptom was trismus and not opisthotonos.

(δ) *Reflex Epilepsy*.—In some cases of epilepsy (Nussbaum, &c.) the attack is preceded by violent pains, localised distinctly in different nerves, and, in these cases, very marked relief (amounting to cure in several instances) has been obtained by stretching the nerve-trunks thus indicated. Possibly, those cases in which an attack can be warded off by tightly ligaturing the limb in which the prefatory symptoms appear, could be similarly benefited.

(ε) *Paralysis*.—Paralysis of movement, in cases where a nerve-trunk has been damaged but not divided, have been relieved by lifting the nerve from its bed, freeing it from its attachments, and gently stretching it. The operation has been performed in cases of paralysis from central lesions, with the obvious result of discredit to the operation and operator. Motor inco-ordination in cases of locomotor ataxy is said to have been improved by nerve-stretching; but this requires confirmation, especially as several cases of motor inco-ordination thus relieved do not appear, from the clinical records, to have been genuine cases of ataxy.

B. *For Abnormalities of Sensation*.—

(a) *Hyperæsthesia*.—Just as in the case of disturbances of movement, those cases of aberrant sensation which are due to direct injury, &c., of the nerve-trunk are those which are most relieved by nerve-stretching. Hyperæsthesia, however, may be due to central causes, capable of relief by operation where diagnosis is possible. In stretching nerves for the relief of pain, it is to be remembered that although it must be thoroughly done, still less force is required than when disturbances of movement (e.g. spasms) have to be treated. A second point of considerable practical importance is the possibility of the pain disappearing *gradually* after the operation, in consequence, no doubt, of the gradual absorption of fluid, &c. It frequently happens that the patient experiences some pain (almost always much mitigated) for several days, but cure is ultimately certain if the operation is thoroughly carried out.

(β) *Neuralgia, Sciatica, &c.*—The causation of the pain in these cases has already been discussed, and after ordinary means have been exhausted (e.g. counter-irritants, anodyne applications, deep injections, &c.), nerve-stretching, or, in the case of a purely sensory nerve, nerve-avulsion, will almost certainly result in cure, since the percentage of successes appears, at the lowest estimate, to be 74 per cent. (Marshall). The special points in connection with nerve-stretching for neuralgia and the pathology of the affection have already been discussed, so that no more need be said here on the subject, save that occasionally a tumour (psammoma) may grow in the membranes covering the long roots of the nerves in the spinal canal (Marshall).

(γ) *Lightning Pains (Tabes)*.—As locomotor ataxy often exhibits peripheral lesions and symptoms, it is not surprising that the lightning pains in that affection have been considerably relieved by nerve-stretching. Owing to the low trophic level of tabetic tissues, special attention must be paid to the wound in these cases, and the condition of the nerve noted before it is pulled. The relief from the pains varies in duration considerably in different cases, but always appears to have been gratefully appreciated by the patient.

(δ) *Anæsthesia*.—The relief of anæsthesia by nerve-stretching has been employed, with especial success in cases of anæsthetic leprosy, by the British surgeons in India. Lawrie published 30 cases, all successful; in fact every case appears to have been so. *Nerve-splitting* has also been found of service, especially where the nerve has become nodose and thickened.

C. *For Abnormalities of Nutrition*.—In 1881, Dr. Bastian caused the sciatic nerve to be stretched to improve the state of nutrition, in a limb the seat of infantile paralysis. The effect was to markedly increase the temperature and colour of the part, and apparently improve the state of the tissues.

VICTOR HORSLEY.

NERVES, Injuries of. — SECTION.—Like all other parts of the body, nerves may be injured in various ways; of these, section by a sharp cutting instrument, such as a knife, is at once the most common and simple. The changes that occur in the nerve-ends after division may be shortly described as follows. The whole of the peripheral portion undergoes degenerative changes in its entire length and distribution. The white substance of Schwann becomes segmented and collects in globules of

varying size within the sheath; finally, the whole of the myelin is destroyed. The axis cylinder splits into numerous longitudinal fibrils, and is gradually completely disintegrated. The nerve, as such, is entirely destroyed within four or five weeks.

After this complete degeneration, regenerative changes occur in the peripheral extremity, independently of its reunion with the proximal end. The nuclei of the sheath of Schwann multiply, and, after a time, unite to one another so as to form new axis-cylinders. Around these the myelin sheath is subsequently formed, but seldom attains the natural dimensions. The length of time required for regeneration of the peripheral end is not certainly known, but the writer has seen new nerve-bundles in the peripheral end six months after section, and is inclined to think that a further period of a year or more frequently elapses before regeneration is nearly complete. It is probable that regeneration is more rapid in young subjects than in old; and it is certain that union with the proximal end materially hastens regeneration.

The changes occurring in the proximal end are, unlike those of the peripheral, strictly limited in their extent, being confined to that portion of the nerve immediately above the point of section; according to some authors, to the next node of Ranvier. In this limited portion of nerve the same degenerative changes occur that have been described as affecting the whole peripheral end, but regeneration is much more rapid. The most noticeable condition of the upper end is the bulbous enlargement, which develops immediately above the point of section within a few weeks of the injury, and which is never met with in the nerve below the point of section. This bulb, which is, roughly speaking, about twice the diameter of the normal nerve-trunk on which it is situated, and oval in shape, is generally matted to the surrounding tissues, and feels very tough and resistant to the fingers. On section, numerous nerve-bundles may be seen, and a microscopic examination will show that the bulb in question is made, not only of fibrous tissue, but also of nerve-tubules, smaller in size than is natural, with a proportionately small myelin sheath, and collected into smaller bundles than are those of nerves in a normal condition. These tubules are either persisting ones, which have altered in size on account of the pressure to which they have been subjected by the dense fibrous tissue, or else new tubes in process of development.

The Union of the Divided Nerve is brought about by a gradual development of new axis-cylinders from the nuclei of the sheath of Schwann, in both the proximal and peripheral ends, forming a uniting medium through which, when perfected, nerve-currents may be transmitted. Whether union will occur in any individual case or not, depends much upon the amount of separation of the divided ends. When these are maintained in close contact and in good apposition, union is both more rapid and more perfect than in the absence of such conditions; yet, even when closely apposed union may fail. If, on the other hand, there is wide separation of the divided ends, and especially if muscle or scar-tissue intervene, union will most likely not occur at all, and in any case will be long delayed. But, though delayed, union may occur even after excision of as much as two to three inches of a nerve-trunk.

The changes that occur in the parts supplied by the divided nerve are many and various. They affect mobility, sensitiveness, and nutrition.

The muscles supplied by the divided nerve are at once paralysed, and remain in this condition so long as reunion is delayed. Not only are they paralysed, however; they also rapidly waste and degenerate. The atrophy of the muscle is much more than can be accounted for by simple want of use, and is infinitely more rapid and complete. It is accompanied by degenerative changes in the intimate structure of the muscular substance, which becomes the seat of fatty change. Within three or four months the muscles have practically disappeared; and not only does the affected muscle diminish in bulk, it also becomes actually shorter, and may thus cause considerable interference with the freedom of action of other muscles. Notwithstanding their complete atrophy, the muscles become entirely regenerated if union of the divided nerve ensues.

The electrical reaction of the muscles, after section of their motor nerve, is a point of some interest and importance. Within twenty-four hours of the nerve-section, their faradic irritability begins to diminish, and within four or five days is completely lost. In the first day or two after the nerve-injury the galvanic irritability may be increased, but is more frequently not appreciably altered. After this time it gradually diminishes, and in the course of three or four weeks the strongest current fails to produce any contraction. It is during and before this period of diminishing galvanic irritability

that the 'reaction of degeneration' becomes marked. Normally, the kathodic closure contraction of a healthy muscle is greater than the anodic closure contraction. After nerve-section, when degeneration sets in, the anodic closure contraction first becomes equal to, and then greater than, the kathodic, a reaction which indicates degeneration of muscle and nerve, and is therefore a valuable diagnostic sign. After union of the divided nerve has taken place, voluntary power in the previously paralysed muscles returns before faradic or galvanic irritability. The patient may be able to use the muscle for many months before it will contract on application of the electric current.

Loss of Sensation.—Supposing the divided nerve to contain sensory fibres, sensation will be more or less impaired after injury. In most cases complete anæsthesia results, the patient losing all sense of touch and pain, of heat and cold. In other cases, and especially where the part is supplied by nerve-filaments derived from more than one trunk—e.g. the ring finger, which is supplied by both the median and the ulnar nerves—more or less sensibility may persist.

In testing the amount and extent of impaired sensibility, it is necessary to be very careful. Examination of a supposed anæsthetic area should always be made in such a manner as to exclude the possibility of exciting sensory impressions through the medium of neighbouring nerves. Thus, if a finger be pressed or pushed, the patient may perceive through his 'muscular sense' that it is being touched. Or, if the supposed anæsthetic area be tested by the surgeon gently rubbing it with his finger, the vibrations conveyed to the neighbouring healthy nerves will correctly convey tactile sensations. In order, therefore, to avoid being misled, all examinations should be conducted with as little interference as possible with neighbouring parts. The point of a pencil is as good as anything for testing the sense of touch; and the surgeon should notice not only whether the patient can *feel*, but whether he can also correctly *localise* his sensations.

Trophic Changes.—The alterations in the nutrition of the paralysed parts is of much importance. It has already been mentioned that the muscles not only atrophy, but also degenerate. The skin is liable to be attacked in various ways. In some cases there is not much alteration, but in most the surface becomes smoother than is natural, and occasionally, in addition, shiny and glistening, the papillæ appearing to be obliterated. Eruptions of eczema, herpes, or acne may result.

In many cases ulcers appear in the anæsthetic area, and are frequently due to injury of some kind or another which, on account of its painlessness, has passed unnoticed by the patient. Sometimes, however, these ulcers occur while the part is completely protected, and must then be attributed to interference with the trophic nerves. When protected, these ulcers will generally heal, though they may be slow to do so.

In addition to ulcerations, local gangrene may result from nerve-injury—e.g. the finger-tips may be destroyed; the gangrene is of the dry variety. Painless whitlows, with loss of the nails, are also not uncommon. The hair of the affected area frequently falls off, and in other cases becomes brittle and stumpy. The nails may be cast off entire, or may become fibrous and brittle, very curved, ridged, and furrowed. Their appearance is often very characteristic.

Disease of the Articulations.—The joints supplied by a divided nerve generally suffer in proportion to the affection of the soft tissues. An interval of considerable length may intervene between the nerve-injury and the joint-disease, but, in some cases, the latter commences within a few days of the former. The pathological processes that occur are not, as a rule, in any way different from those met with in acute rheumatism. There is the same synovitis with exudation of plastic lymph, the same tendency to affection of the fibrous tissues of the articulation, and, as in acute rheumatism, the inflammation may entirely resolve. Fibrous ankylosis, is, however, much more common after nerve-injuries than in simple rheumatism, and, indeed, may almost be said to be the rule rather than the exception. The writer has seen one case, at least, of true bony ankylosis.

Many or few joints may become inflamed, but when one of the nerves of the upper extremity, which supply the hand, is the seat of the injury, many of the finger-joints are commonly affected.

Clinically, as well as pathologically, these cases resemble closely acute or sub-acute rheumatism on a limited scale. The diseased joints become slightly swollen, extremely tender to the touch, and painful on movement. Gradually, the more acute symptoms pass off, and, in the larger number of cases, a more or less complete ankylosis remains. This ankylosis is, as a rule, incomplete, and over a limited area movement is fairly free. The extent to which a limb may be crippled by this form of arthritis can scarcely be exaggerated, and, occurring as it does in combination with

other trophic lesions, it is liable to be accompanied by an amount of deformity and suffering not easily exceeded.

Alteration in Temperature.—The immediate result of division of any of the main nerve-trunks of the extremities is vaso-motor paralysis, and consequent hyperæmia of the paralysed area. As a result of this increased blood-supply, the temperature is raised above that of the corresponding part on the opposite side. The increase in temperature varies in different cases, but is usually about two or three degrees. After a few days, the alteration in temperature is less marked, and in the course of a few weeks the temperature not only sinks to the former level, but the paralysed area becomes several degrees colder than is normal. The fall may amount to eight or ten degrees.

The changes that have just been described as following on nerve-section, may also be met with as the result of any other injury to a nerve. It is quite a mistake to suppose that the various trophic changes are dependent upon some irritated or inflamed state of the nerve-trunk, for they are met with after simple section in cases where the nerve is completely divided, and in no way implicated in scar-tissue. In addition, it must be remembered that, within a few days of section, the degenerate nerve-tubes are quite incapable of conveying any nervous currents, and cannot therefore be the means through which the nutrition of the tissues may be actively influenced.

Diagnosis of Nerve-section.—The diagnosis of division of a peripheral nerve is usually an easy matter. In recent wounds, however, unless the surgeon bears in mind the possibility of such an injury, he is not at all unlikely to overlook it, the paralysis and loss of sensation being frequently unnoticed or uncomplained of by the patient. Later on, the muscular wasting and shortening, the 'reaction of degeneration,' evidenced by the use of the galvanic current, the paralysis, trophic changes, and loss of sensation make the diagnosis sufficiently clear. It must be borne in mind that, from a diagnostic point of view, the evidence adduced from an examination of the muscles is of much greater weight than that derived from an examination of the sense of touch, which, as has already been mentioned, may be to a great extent preserved.

TREATMENT OF DIVIDED NERVES.—In all recent cases of division of nerve-trunks, primary suture of the divided ends should

be performed. The nerves are very elastic, and on section retract to considerable distances, frequently necessitating an enlargement of the wound. If the cut ends are at all jagged or torn, fresh sections should be made, and contact ensured by thorough stretching. From three to six sutures are generally requisite, and are best passed by means of a small curved needle carried in the long axis of the nerve-fibres. It is quite immaterial whether the needle be passed through the whole thickness of the nerve-trunk or only through the sheath, so long as thorough apposition is obtained. There is no reason for believing that passage of a needle through the nerve inflicts any serious harm.

The best material for sutures is fine kangaroo-tendon. The writer's preference for this material is based upon the fact that he has seen cases in which suture with carbolised catgut failed, apparently because the sutures did not last a sufficient length of time. It must be remembered that nerves do not unite rapidly; if, therefore, there be any tension on the part, it is certainly advisable to use some material which will maintain the divided ends in apposition for a longer time than does catgut. Every endeavour should be made to obtain primary union of the wound, for, if much suppuration occur, separation of the recently united nerve by inflammatory products, or matting in fibrous tissue, is likely to ensue.

Supposing the divided nerve to have escaped primary suture, and the patient is not seen for some months later, an operation for resection of the separated extremities and secondary suture should be undertaken. There are not at present a sufficient number of recorded cases to allow of any opinion being offered, as to the amount of time that may elapse after which suture can be successfully performed. The operation should, therefore, not be withheld, in any case, simply on account of the length of time that has elapsed since the original injury. The application of an Esmarch's bandage materially facilitates the search for the nerve, but, at the best, the operation is liable to be prolonged. The incision should be made in the long axis of the nerve at the seat of injury.

It is often advisable to expose the nerve-trunk above or below, and then to trace it down until the cut end is reached. The divided ends are always adherent to the surrounding tissues, the upper being bulbous, the lower often atrophied. They should be freely separated and fresh sec-

tions out as cleanly as possible. There is no object in cutting away much of the lower end, for it is all equally atrophied. Neither need the entire bulb be removed—though the greater part of it should be—for it offers a better hold for the sutures than does the nerve-trunk itself. If the nerve seems much shortened, the ends should be thoroughly stretched before being sutured, and the limb should be put up in such a position as to ensure as little longitudinal tension as possible. The sutures should be of the same material and may be passed in the same way, as has been described in the account of primary suture.

The *prognosis* of cases in which nerve-suture has been performed must be somewhat uncertain. When the patient is young, when good apposition has been obtained, and when the wound has healed by first intention, it is most probable that the functions of the nerve will be restored, either completely or else in part. In some cases sensation may return and motion may never be regained; in other cases the reverse holds good.

The *length of time* required for this restoration is most various. In recent cases primary union of the divided ends is but rarely attained, and the process of degeneration and subsequent regeneration is necessarily a lengthened one. In cases of secondary suture, sensation sometimes commences to return within twenty-four hours, but a much longer time is requisite for the restoration of the atrophied muscles. In many cases, the surgeon must not be disappointed if no improvement makes itself apparent for weeks or months. The writer has seen patients, in whom restoration of function did not commence until nearly two years after suture. But, whilst waiting for repair, other treatment should by no means be neglected; it is most important to prevent, as much as possible, the deformities and trophic lesions which are almost certain to ensue. Perhaps the most important rule to observe is that the whole extremity which is the seat of injury, and especially the paralysed part, should be kept warm; cold is certainly prejudicial, and repair in many cases is apparently more rapid during the summer than the winter months. Galvanism is often useful, even in cases where muscular irritability is absent, and appears to have some influence in maintaining the nutrition of the part. It should be persevered with so long as any hope of union remains. Daily friction and shampooing of the limb should be practised, and any tendency to fixation of joints and muscular contrac-

tion should at once be combated. The treatment of cases of arthritis is most unsatisfactory at best. In the early stages, blisters are sometimes useful, and, as early as the inflammation allows, the patient should be anæsthetised and all recent adhesions be broken down.

PARTIAL SECTION.—Contrary to the opinions of some authors, the writer is quite convinced that partial section of a nerve-trunk is by no means so severe a lesion as complete division. It has been stated that trophic lesions of various kinds are more frequent after partial than after complete division. The writer has observed several such cases during considerable periods of time, and feels certain that the amount of paralysis, of anæsthesia, and of trophic lesions is in direct proportion to the amount of nerve-fibres divided. The prognosis of union in such cases is also better than in those of complete division, for the divided tubules are but little separated, and so can more readily rejoin.

In recent cases of partial division it is as well to suture the divided strands, more especially in cases where almost the whole trunk has been severed. If, however, the patient is not seen until the wound is healed, the treatment to be adopted will depend on the amount of function that is lost. Supposing this to be very considerable, it is advisable to cut down on the nerve at the seat of injury, then to resect the ends and perform secondary suture, if division be found to be practically complete. It is always best to do this if the functions of the injured nerve are almost lost, for it must be remembered that those which remain may be really dependent upon some abnormal distribution of another nerve-trunk, complete division of the damaged nerve having really occurred. Where an examination tends to show that but few nerve-fibres have been divided, the case may fairly be left alone so far as operation is concerned.

INJURIES TO PERIPHERAL NERVES.—Considering the almost innumerable injuries of peripheral nerves, it must be allowed that severe symptoms resulting from such an accident are relatively uncommon. It is probable that when symptoms do arise, they are due to implication of the nerve in the scar-tissue and to secondary neuritis, and not directly to the nerve-wound; and it is because a partially divided nerve can less readily contract, and so escape inclusion in the scar, that partial division of a filament is more likely to be followed by troublesome symptoms than if the division has been complete. The symptoms of injury to or irrita-

tion of a peripheral filament are—reflex contraction of neighbouring muscles, producing painful spasm, rigidity, and uselessness of the injured extremity; pain of a neuralgic nature radiating over an area of varying dimensions; occasionally, paralysis of neighbouring muscles. In hysterical patients the health may be seriously affected.

The *treatment* of such cases consists in removing the cause. If the wound has cicatrised, it will frequently be found that at one spot the cicatrix is extremely sensitive, and that any pressure exercised in this situation at once causes radiating neuralgic pains, and perhaps muscular spasm. If this be the case, the cicatrix should be completely excised. If any suspicion exist that the pressure of some foreign body, such as a shot, is the exciting cause of the symptoms, a careful examination of the supposed seat of irritation should be made, and any foreign body should be removed.

PRESSURE ON NERVES.—Pressure may be applied by external objects, or may be due to the growth of tumours, displaced bones in cases of dislocation, the callus thrown out in repair of fractures, implication in cicatrices, &c. The effects of pressure on a mixed nerve are most apparent in respect to its motor function; paralysis of muscle may be present, while sensation is retained; the reverse is rare. Cases of crutch palsy afford good examples of the effects of extraneous pressure, whilst paralysis from pressure on the nerves of the arm during sleep—especially drunken sleep—is also of common occurrence.

The *diagnosis* of such cases is usually easy, and the *prognosis* is good. *Treatment* by galvanism and friction, with abstinence from the use of the crutches, if these are the cause, usually results in a cure within a few days or weeks. Pressure on nerve-trunks by cicatrices is generally characterised by the gradual onset of the symptoms which are common to all cases of nerve-injury. Thus, the anæsthesia is preceded by numbing and tingling pains, and by parasthesiæ of various kinds. Paralysis and wasting of muscle are also gradual. Trophic lesions are slowly established. Such symptoms as those accompanying the gradual contraction of a cicatrix are a sufficiently clear evidence of pressure on a nerve. Supposing the anæsthesia and paralysis to continue, after a sufficient length of time has elapsed to allow of the cicatrix becoming more supple and less adherent, an operation should be undertaken in order to free the compressed nerve from the fibrous mass in which it is embedded.

INJURIES OF NERVES IN FRACTURES.—LACERATIONS OF NERVES.—Were it not for the extreme elasticity and toughness of the nerve-trunks, there is no doubt they would suffer in cases of fracture much more frequently than is actually the case. They do not, however, always escape. There are two ways in which nerves may be damaged in cases of fracture. They may either be torn at the time of the accident, or they may be compressed by callus. If torn at the time of the accident, the symptoms will, of course, supervene immediately, whereas, if gradually implicated in callus, the onset will be gradual, in the manner already described as occurring in cases of pressure on nerves by cicatrices.

Where a definite history of sudden, or else of gradual loss of function can be obtained, the diagnosis is rendered comparatively easy. This, however, is by no means always the case. The pain of the injury, the subsequent bandaging and splinting of the damaged limb, frequently prevent the patient having any very clear idea of the condition of his sense of touch and of his muscular power. It is often not until the splints are removed that paralysis or numbness is noticed. But even when the surgeon feels satisfied that a nerve is torn at the time of fracture, it is in all cases advisable to wait until union of the broken bone has occurred. Secondary suture of the lacerated trunk offers prospects of union which are practically as good as those of primary suture; and it is not worth while to make a simple fracture into a compound one, in order to unite a torn nerve.

The *treatment* of the injured nerve after union of the fracture has occurred is, however, clear. If there be any doubt as to whether it is a case of nerve-laceration, or one of callus-implication, it is as well to wait and see if improvement results as the callus is absorbed. If no such improvement occurs, an exploratory operation should be undertaken, the nerve should be exposed, and, if torn, should be sutured. If, however, there is no laceration of the nerve, but it is implicated in callus, the bone which surrounds it should be chiselled away. In some instances true pressure may be exercised, not by callus, but by fragments of comminuted bone. The writer has seen one such case, in which removal of an outlying portion of bone which compressed the median nerve and caused paralysis, was followed by rapid disappearance of all symptoms.

NERVE-INJURIES IN DISLOCATIONS.—As in fractures, so in dislocations, nerves

may be torn at the time of accident, or else simply compressed by the displaced bone. They may also be torn in attempts at reduction. It is in connection with dislocations of the shoulder-joint that such troubles are most likely to occur, and not only may the nerves forming the brachial plexus be torn in the axilla, but the whole of the cords of the plexus may be torn out from their attachments to the spinal cord.

The *treatment* of such cases is often most unsatisfactory. Where the dislocation is unreduced, and the symptoms are due to the pressure of the displaced bone, much improvement generally follows on reduction; but where the nerve-trunks have been torn, the case is little likely to improve, and though an operation for suture may be undertaken, the difficulties attending it are generally very great.

CONTUSIONS OF NERVES.—A severe blow on a nerve-trunk may be followed by all the symptoms which ensue on complete section; in other cases sensation may be lost while motion is retained; or the reverse may occur. The nerve itself may be either simply contused, and to the naked eye may present no abnormal appearance, or else it may be entirely crushed. The *prognosis* in these cases is necessarily most uncertain. It is not possible to ascertain accurately the condition of the nerve. In many instances rapid restoration of function ensues. In others, improvement is so slow that two or three years may elapse before the functions are entirely restored; and, in yet others, no repair ensues. The *treatment* is practically the same as that already recommended in cases of nerve-section.

PUNCTURED WOUNDS OF NERVES.—Punctured wounds of nerves are sometimes followed by symptoms indicating division of some fibres and irritation of others. Thus, partial anæsthesia and paralysis, with muscular wasting, may be combined with hyperæsthesia, and neuralgic pains with muscular spasm. In the early stage, the treatment consists of rest in order to allay the irritability of the damaged fibres, which are only in part divided, and are liable to be implicated in any inflammation that results from the injury. In the later stages, when the irritability has passed off, the treatment already recommended in cases of nerve-section should be adopted.

NEURITIS.—Neuritis may supervene upon any injury to a nerve, but it is fortunately of rare occurrence. There is no doubt that the cut ends of all divided nerves are most usually implicated in the inflammatory process by which the wound is healed;

but such inflammation is strictly limited to the injured portions, and causes no definite symptoms. The form of neuritis which is here alluded to tends to spread along the whole length of the nerve. It may be either acute or chronic. The changes common to all inflammatory processes are combined with gradual destruction of the nerve-fibres and swelling of the whole trunk.

The *symptoms* are intense pain both in the course of the inflamed nerve and also in its peripheral distribution, combined with muscular spasm, atrophy and trophic lesions. *Treatment* consists in rest, cooling applications, and leeching. In chronic neuritis, counter-irritation is most efficacious, and in obstinate cases nerve-stretching should be resorted to.

ANTHONY A. BOWLBY.

NETTLE-RASH. See URTICARIA.

NEURALGIA.—Neuralgia may be shortly defined as local pain without local signs of inflammation or disease.

Causes.—The causes are predisposing and exciting, but in very many cases of neuralgia no definite cause can be assigned. With regard to the first, an hereditary tendency to nervous affections—e.g. epilepsy or lunacy—is the most important. Any debilitating influences, whether mental or physical, predispose to neuralgia. The chief exciting causes are: 1. Exposure to cold. 2. Pressure or irritation of nerve-trunks. 3. Peripheral irritation. 4. Irritation or disease of the central nervous system.

1. Exposure to cold appears to act by setting up inflammatory changes around the nerve, but the exact manner in which the nerve is affected is not certainly understood.

2. Nerve-trunks may be compressed or irritated either by pressure on them, or implication of their substance by a tumour, or else by surrounding inflammation—e.g. the neuralgic pains caused by pressure of a thoracic aneurism upon the intercostal nerves is sometimes very severe. The pain is referred to the periphery of the affected nerve. The implication of nerves in the scars of cicatrising wounds affords an excellent example of pressure by inflammatory exudation. In stumps, neuromata are commonly found (see NEUROMA), and are the source of very severe neuralgic pains. Sometimes, slight wounds of the digits or other parts are followed by extremely tender cicatrices, pressure on which at one particular spot causes intense shooting pain, due to inclusion of a small nerve-filament at this point.

3. Peripheral irritation may reflexly cause neuralgic pains in very distant parts; surgically speaking, this is one of the most important causes of neuralgia. The following may be adduced as instances of this reflex neuralgia. A stone in the kidney may cause severe neuralgia of the testis; a carious tooth may cause facial neuralgia in any of the branches of the fifth nerve; a wound in the hand may cause pain in the arm or neck; a foreign body, such as a shot, pressing on a peripheral nerve may cause neuralgic pains, which are referred to all parts of the affected limb.

4. The irritation of a tumour pressing on the brain or spinal cord may cause neuralgic pains in distant parts. Pressure on the cord or nerve-roots, in spinal caries, often results in severe pains in the chest and abdomen. Structural disease of either the brain or cord may produce similar symptoms.

Symptoms.—The one essential symptom is pain. This pain is localised more or less accurately to the area supplied by a certain nerve or nerves. It is usually described as of a darting, shooting, or plunging character, and radiates from a central point. Pressure, upon the spot where the affected nerve emerges from beneath the deep fascia or from a bony canal, intensifies the pain.

Epileptiform neuralgia is the name given to a very severe and fortunately rare form of this disease, which from its obstinacy is very liable to come under the notice of the surgeon. This most painful affection (which is well described by Trousseau in his *Clinical Medicine*) almost invariably attacks the face, and may follow the course of any one or of all of the branches of the fifth pair of nerves. There are two varieties. In the one the pain is accompanied by spasm and twitching of the facial muscles; in the other there is no such spasm. The pain is not constant but paroxysmal, and is liable to much variation. As in other forms of neuralgia, many weeks or months may elapse between the attacks, which, when they supervene, are liable to be repeated day after day for a considerable time. The patients vary in age, sex, and constitution. They may be old or young, men or women, robust or weakly.

The paroxysms of pain are usually of a most startling character, and their onset is very sudden. Their duration varies from four or five seconds to half a minute, seldom exceeding the latter limit. They may be repeated so rapidly that the intervals are scarcely appreciable, or a considerable time may elapse between the paroxysms. The paroxysm may be started

by various causes, most of which act on the peripheral distribution of the fifth nerve. Quite suddenly, without a moment's warning, a draught of cold air, an attempt to swallow liquid or to masticate food, the slightest touch of the hair of the face or of the skin, an attempt at speaking, or a sudden noise may be followed by a severe pain. This, commencing at a single spot, rapidly radiates over the whole of the branch of the nerve which supplies the surrounding area, and spreads in many cases to the remainder of the face. At the onset of the paroxysm the patient frequently appears to lose all self-control. He grasps his head with both hands as though he would crush it, he clenches his teeth, clutches violently at surrounding objects, or writhes in agony on the floor. It is impossible to exaggerate the sufferings of these patients.

The precise character of the pain varies at different times and in different patients. To some it is 'like a bundle of red-hot wires being driven into the face and then twisted in all directions' (Walsham), to others of a stabbing and cutting character. Some patients describe the pain as similar to that experienced by severe crushing of a part, others say it is 'as if the flesh was being torn away.' The mucous membrane of the lips, gums, and nasal cavities is just as much the seat of pain as is the skin, and in some instances the secretions are variously altered, the nostril becoming hot and dry, or the eye becoming full of tears.

On account of the frequency with which movements of the mouth cause an attack, the patient often presents an appearance of extreme caution in his actions. When speaking, he does so with clenched teeth, and with lips scarcely parted. In eating and drinking his movements are very slow. His face is kept wrapped up to prevent the contact of any foreign body or of a sudden blast of cold air. Sometimes, under the perpetual mental strain, the patient's health gives way, for he is often almost incapacitated for sleeping or eating and drinking, and his whole thoughts are concentrated on himself. In other instances the health is maintained in a manner which is very surprising, and the general appearance of the patient, when free from pain, is often most deceptive. Occasionally, the subjects of epileptiform neuralgia seek relief from their sufferings in suicide, a termination which sufficiently emphasises the severity of the complaint.

Diagnosis.—The diagnosis of neuralgia is not difficult, but care is necessary not to

confound the pain caused by real and serious disease with a pain that is purely functional.

Treatment.—Apart from medicinal treatment, which will not be considered in the present article, the first essential is to discover and remove the cause. Thus, research should be made for any tumour or inflammatory growth forming on a nerve-trunk, for any source of peripheral irritation, and for disease of the central nervous system. Neuralgia of the fifth nerve has been completely cured by removing small fibrous growths on the gums, and by gouging away the alveolar borders of the jaw-bones, where these have been found to be unduly sensitive to pressure. In many cases, counter-irritation by means of blistering fluids, iodine, &c., produces excellent results; and in cases of neuralgia of the extremities a thorough course of 'massage' and shampooing is often most beneficial. In cases of sciatica and other neuralgic pains of the limbs, galvanism sometimes gives great relief. It should be applied for a space of ten or fifteen minutes daily, and must be persevered in for several weeks before a cure can be expected. The current need not be a very powerful one.

In addition to the removal, if possible, of the exciting cause, the operations of NEUROTOMY, NEURECTOMY, and NERVE-STRETCHING may be advantageously employed. The chief objection to the two former is that, except in the case of purely sensory nerves, the resulting paralysis from division of motor as well as sensory branches is a most serious evil, and every other method should be thoroughly tried before such an operation is undertaken on one of the nerve-trunks of the extremities. In cases of neuralgia in any part of the body, but especially in the case of such a disease affecting the branches of the fifth nerve, neurotomy almost always gives temporary relief. In some cases the relief is permanent, but in many more it is only temporary. The return of pain in any given area must not be interpreted as implying a reunion of the divided nerve, for this comparatively rarely occurs. Neuralgia is often reflex, being excited by any peripheral irritation; and where the original source of irritation has been removed, the nerve-centres may yet remain in a state of undue irritability, and may be excited by irritation of any other centripetal branch. In spite of such obstacles, the operation of neurotomy is fully justifiable in cases of obstinate neuralgia.

If neurotomy fails, the operation of neurectomy may be undertaken. The

rationale of such a proceeding is that after excision of a portion of the nerve-trunk reunion is less likely to occur. This is certainly true, but in most cases the return of pain is not due to such repair. It is the opinion of the writer that such an operation excels neurotomy only in those cases in which the excision of a portion of the nerve involves the division of other sensory branches—e.g. in excision of the infra-orbital the branches to the teeth and palate are also cut away. In all cases of neuralgia severe and obstinate enough to call for operative interference, nerve-stretching should always be practised before either neurotomy or neurectomy, for it is often equally or even more efficacious, and in the case of the motor nerves the damage done to peripheral parts is infinitely less. Further, in those cases in which neurotomy or neurectomy are performed, it is certainly advisable to combine nerve-stretching with such a procedure, the nerve being stretched before it is cut. The operation is one of universal application in all cases of neuralgia.

The treatment of epileptiform neuralgia is most unsatisfactory and uncertain, yet good and permanent results do follow surgical interference in a certain number of cases. As in other forms of neuralgia, nerve-stretching of either the inferior dental, the supra- or infra-orbital should be tried before division of these trunks, but either neurotomy or neurectomy, or excision of Meckel's ganglion, may be practised. Each operation is generally followed by some period of relief; the pain may not return for months, and it must be borne in mind that many patients are quite willing to purchase temporary immunity at almost any cost. They will submit to operation after operation, so long as the faintest hope of benefit remains.

ANTHONY A. BOWLBY.

NEUROMA.—A neuroma is a tumour of a nerve, but the structure of neuromas varies. They may be divided into (a) true, (β) false. (a) A true neuroma is one which is composed of nervous tissue. This tissue may either consist of nerve-fibres, medullated or non-medullated, or else of true ganglionic cells with a surrounding network of fibres. In almost all true neuromas the nerve-tubules are not continuous with those of the nerve-trunk to which they are attached, and, as a rule, are not arranged in any definite order, but form an irregular network mixed with a varying amount of loose connective tissue. The majority of the fibres are smaller than those composing

a normal nerve, and often, some of them have scarcely any medullary sheath. Although the matrix in which these fibres lie is generally composed of connective tissue, it may consist of myxomatous or sarcomatous elements. Neuromas composed of nerve-fibres or of ganglionic elements are very rare; the writer has not seen such a case.

(β) A false neuroma is a tumour situated on a nerve, and not itself containing any nerve-elements. There are several varieties of false neuromas, but the most common of such tumours are fibromas. These consist almost entirely of white fibrous tissue with but few connective tissue cells. Myxomas, gliomas, and sarcomas are also met with in nerves, the latter more commonly than the former. They differ from the fibromas in the greater rapidity of their growth, in their tendency to infiltrate rather than simply to push aside the nerve-tubules among which they grow, in their greater softness and succulence, and in their cut section being pink, homogeneous, and gelatinous, instead of white, shining, and fibrous.

Neuromas, either true or false, are most common on the nerve-trunks of the extremities; they vary in size from a pin's head to an egg, but are most commonly about as big as a nut. In shape they are usually rounded or oval, smooth on the surface and firm to the touch. Neuromas, especially those composed of fibrous tissue, frequently lie between the nerve-bundles, pressing them aside and not actually involving them in their growth. But, in other cases, one or more of the nerve-bundles may pass completely through the tumours.

Another variety of neuroma is the traumatic neuroma, which is met with in stumps after amputation, or in any nerve that has been completely or partially divided. Such tumours vary in size according to that of the nerve on which they are situated; they are, roughly speaking, about twice the diameter of their nerve-trunk, and their length is about double their width. They are smooth and oval, tapering at their extremities, and directly continuous with their nerve-trunk. They are generally adherent to the surrounding tissues, and, on section, may be seen, with the naked eye, to be composed of longitudinal bundles lying in a fibrous matrix. Under the microscope, they are found to consist of a mixture of fibrous tissue and nerve-tubules. The latter are smaller in diameter than normal nerve-fibres, and appear to be either old fibres which have atrophied from pressure, or else young tubules which are not fully developed.

In some cases the nerve-trunk above the neuroma is thickened and indurated to a variable length.

The 'painful subcutaneous tubercles' which are met with in the subcutaneous tissues—chiefly of the extremities—are included by some authors amongst the neuromata. The writer has examined many such tumours, but has never been able to demonstrate any connection with a nerve-filament. They are composed of fibrous tissue, and are most commonly found in women.

The *diagnosis* of neuroma depends partly on the symptoms induced by their presence, and partly on the physical characters they present when examined. The attention of the patient is first called to the tumour by pain, which varies in its character. It is felt both at the seat of growth and in the parts to which the affected nerve is distributed. It is often continuous, but is liable to sudden exacerbations. It is sometimes of a dull, aching, numbing character, but more often sharp, shooting, and of a neuralgic nature. As in true neuralgia, so in neuroma, the pain often radiates beyond the affected trunk, so that other neuromas may be suspected where none are really present. In addition to pain, the pressure on the nerve-trunk gives rise to various paræsthesiæ, and the patient complains of numbness, 'pins and needles,' tingling, and formication in the parts to which the nerve is distributed. Where the sensory nerve-fibres are completely compressed or crushed by the growth, absolute anæsthesia will ensue. This is rare. Muscular movements of a twitching character, and, occasionally, choreic or epileptiform convulsions result from irritation of motor fibres, whilst the complete compression of the same is indicated by paralysis of the muscles supplied by them.

The interference with the trophic nerve-fibres by the growth in rare instances results in the production of various so-called trophic changes. The chief of these are a smooth, glossy appearance of the skin, striation and brittleness of the nails, ulceration of peripheral parts, painless whitlows, loss of hair, increase or diminution of sweat, and wasting and loss of faradic contractility of the muscles.

On clinical examination by the surgeon, a neuroma will be found as a smooth, oval or rounded swelling, varying in size as before mentioned, and situated in the course of a nerve-trunk. It can readily be moved in a lateral direction, but is found to be scarcely, if at all, movable in the long axis

of the nerve on which it is placed. Pressure upon the tumour causes pain, both at the seat of the swelling and also in the parts applied by the diseased nerve; the latter point is important. The pain caused by the presence of the neuroma may be allayed by pressure exercised upon the nerve-trunk, between it and the spinal cord. The diagnosis of neuroma having been made, an opinion as to its intimate structure must depend chiefly upon the rapidity of its growth; in proportion as this is rapid, the probability of the sarcomatous nature of the tumour is increased.

Finally, it may be mentioned that neuromas, both innocent and malignant, may be multiple, being found in some instances on almost all the nerve-trunks of the extremities.

Treatment.—There is but one effectual treatment for neuromas, and that is removal by the knife. The incision should be made in the long axis of the affected nerve, and the tumour carefully enucleated with as little injury to the adjacent nerve-bundle as possible, for it should be remembered that, in many cases, the neuroma may be removed without dividing the nerve-trunk. In all cases in which excision of a portion of the diseased nerve becomes necessary, this should first be forcibly stretched to a sufficient extent to allow of immediate suture of the cut ends. For, if the nerve has been resected without this precaution being taken, it may be difficult or impossible to bring the cut surfaces into apposition. In cases where so large a portion of nerve has been excised as to render suture impossible, the chances of union are rendered much more uncertain, though no case must be regarded as hopeless in this respect.

ANTHONY A. BOWLBY.

NEUROTIC FEVER.—This term, which can only be considered as quite provisional, is here employed to denote that kind of pyrexia which is sometimes seen in patients the subject of severe traumatic lesions of the central nervous system.

Etiology.—Pyrexia has been clinically observed to occur in a number of different injuries and diseases of the central nervous system; and, so varied is the list, that the nature of the lesion can have very little influence of itself, excepting by some peculiarity of the way in which it injures the brain or spinal cord, and, above all, in the frequency with which it attacks certain portions of the central nervous system. The etiology of neurotic pyrexia will therefore be the etiology of a number of

affections grafted on to certain predisposing conditions, which may now be very briefly alluded to.

Such predisposing conditions are race, age, and constitutional disposition. Race has been alluded to elsewhere (*see SURGICAL FEVER*), and the influence of age is very well known, the tendency of young children to exhibit the symptoms of fever, on comparatively slight provocation, being an every-day clinical observation. No apology is here made for using the expression 'disposition,' for, none other being to hand, that will serve as well as any to indicate that in some persons the heat-producing metabolic processes are much less under control than in others, and that consequently, such individuals are, like children, subject to easily produced changes of body temperature. This same condition may be artificially brought about, in otherwise normal individuals, by the prolonged action of severe illness and physical exhaustion.

Pathology.—Although of later years considerable attention has been drawn to this subject, the experimental evidence upon it is extremely incomplete. It will make the situation clearer, perhaps, if we state at once the theory which at present obtains acceptance, and which is based on the work done up to the present time. It being well established that the heat-production of the body is brought about by the metabolic activity of the parenchymatous tissues (especially the muscles, &c.), it follows as a necessary corollary that the rise of temperature will vary in amount—(1) according to the activity of the tissue-metabolism, and (2) according to the state of the vessels on the cooling surfaces of the body. The complication introduced into the question of pyrexia, by necessary consideration of the influence of the vasomotor system in causing loss of heat, may here be passed by, for, as a practical fact, its immediate action is only to diminish the general effect, since the heat-production is much greater than the loss by cooling. We are, therefore, brought to consider the circumstances which influence the activity of tissue-changes, or, in other words, regulate the amount of heat produced. The only one recognised until lately as being possible was movement—i.e. contraction of muscles, produced, of course, by changes induced in the contractile tissues by the action of the central nervous system. But in the large majority of cases of neurotic pyrexia there is no such active movement at all; in fact, there is usually profound and extensive paralysis. We are thus led

to believe that, in these cases, the tissues produce a relatively enormous amount of heat, because their metabolic processes are no longer controlled by the damaged nervous system. General and experimental considerations have further extended this idea, until it is now believed, by some, that there are supreme heat-controlling centres in the cortex of the mid-parietal region of the brain, from which impulses pass down to an important subordinate centre in the medulla oblongata, and thence to smaller centres in the spinal cord. Each of these is supposed to inhibit with greater or lesser effect the peripheral tissue-changes, which consequently become greatly exaggerated when the controlling or inhibitory influence is withdrawn by disease or injury.

Symptomatology.—It will be sufficient if the above pathological theory is illustrated by the commonest clinical conditions, under which neurotic fever is met with in practical surgery. The part played by the central nervous system in the instances of traumatic fever, urethral fever, &c., is alluded to under those headings, and under that of surgical fever. In all these instances the pyrexia has been found to run a fairly definite course. We are now, however, introduced to a series of cases which present no such constancy of temperature curve except at the end—namely, just before death, when the case terminates fatally, as will be subsequently explained. Such cases are concussion of the brain, compression and laceration of the brain, hæmorrhage into the brain, especially into the ventricles and into the pons, laceration of the spinal cord and, occasionally, compression of the same; injury of the cord usually producing pyrexia when the lesion is in the cervical enlargement. Other rarer conditions are—tumours of the central nervous system and so-called hysterical cases. It is obvious, at once, that the weak point in the pathological theory above referred to, and which seeks to explain those cases, is that it is put forward in the absence of knowledge concerning the pyrogenous influence of foreign substances, such as extravasated blood, &c., on the brain or on the dura mater, the sensitiveness of the latter to mechanical stimulation being excessive. We can only repeat that, when the injury occurs in the neighbourhood mentioned above as the theoretical seat of the heat-centres and their connecting fibres, pyrexia is more likely to be produced.

Course of the Pyrexia.—In a large number of cases, the first effect of the injury is to produce a subnormal depres-

sion of temperature from SHOCK. This is quickly followed by reaction, which is accompanied by pyrexia, termed the 'fever of reaction.' If the case terminates fatally in a few hours, the temperature commonly rises steadily but rapidly to 107°–109° F., or even higher (111°, Brodie), and often continues to rise for an hour or two after death. If, on the contrary, the case recovers without another bad symptom, the temperature simply rises to 101° to 102° F., or even less, and falls gradually, to normal within twenty-four hours of its commencing to rise. Not infrequently the case, though ultimately proving fatal, lasts for several days. Under these circumstances the temperature usually rises to a comparatively low degree—viz. to 100° to 102° F.—and remains at about that point until a few hours before death, when it rapidly shoots up to 107° to 109° F., &c., which hyperpyrexia is occasionally continued after death. As hinted above, the hyperpyrexia at the end of these cases is the most striking feature of the temperature curve, and is possibly connected with the customary failure of the central nervous centres before the general systemic processes. In cases of hysterical hyperpyrexia it seems likely that we have to do with functional derangement of the calorific centres, especially such as exist in the cerebral hemispheres.

Prognosis.—Always of the worst, if the temperature rapidly rises towards hyperpyrexia. Bad, if there is profound and prolonged preliminary shock. Good, if with moderate shock the temperature soon reaches a moderate height and as soon returns to normal.

Treatment.—Hopeless, if hyperpyrexia has set in, and the cause is not removed. The ice-pack will be found to reduce the temperature one or two degrees, but it only delays the end a very little time, and the rebound after its use is greater. In cases of simple and moderate 'fever of reaction,' the ice-cap to the head, or, if necessary, iced towels on the trunk, should be applied. The obvious line of treatment, where feasible, is to attempt the removal of the cause of the pyrexia. VICTOR HORSLEY.

NEUROTOMY and NEURECTOMY. By the term 'neurotomy' is implied division of a nerve, by 'neurectomy' excision of a portion of its length. In either case, the nerve is exposed by an incision in a line parallel to its course, dividing the various structures that lie between the nerve-trunk and the surface. As in the case of ligature of vessels, there are certain

'seats of election' for the exposure of the chief nerves, and it is at such places that the nerve-trunks can be exposed with the least amount of damage to the surrounding parts. These operations are much facilitated, in the case of the extremities, by a previous exsanguination of the limb by the use of an Esmarch's bandage; the operation being rendered bloodless, the nerve is more easily exposed and its condition more readily ascertained. After the nerve has been found, it will generally be advisable to remove the bandage before stretching (if this is necessary), for, if left on, it constricts all the tissues to such an extent, that no impression will be made by the operation upon that portion of the trunk which lies above the bandage.

The Supra-orbital Nerve.—The supra-orbital notch can always be readily felt. The nerve, after emerging from the orbit, passes directly upwards towards the scalp. It may be exposed by an incision carried through the skin, fascia, and occipito-frontalis muscle. In this case, as in that of the supra-trochlear, the usual rule of making the incision parallel to the course of the nerve may be departed from, and the skin may be incised in a line parallel with the eyebrow, the reason being that transverse scars on the forehead are less perceptible than are longitudinal ones.

The Supra-trochlear Nerve. — The pulley for the superior oblique muscle may usually be readily felt at the inner angle of the orbit; the supra-trochlear nerve emerges immediately above it, and may be reached by an incision similar to that required for exposure of the supra-orbital nerve.

The Infra-orbital Nerve. — The infra-orbital canal, from which the nerve emerges, is in a line drawn from the supra-orbital notch to the canine tooth of the same side. The nerve may be exposed by an incision in this direction; it will be found at a considerable depth from the surface. In exposing any of the above nerves there is often troublesome bleeding from their accompanying vessels, and the operation generally takes a longer time than might be anticipated.

Meckel's Ganglion.—This ganglion has been excised for the cure of epileptiform neuralgia. It is reached as follows:—A crucial incision is made in the cheek, with its centre opposite to the infra-orbital canal; bleeding having been checked, a portion of the anterior wall of the antrum is removed with a half-inch trephine. A stout bristle, a piece of quill, or a slender probe, is then

passed as a guide along the infra-orbital canal, and the floor of the latter is carefully cut away from below with bone-scissors, until the posterior wall of the antrum is reached. During this part of the operation, great care must be exercised in order to avoid injury to the infra-orbital nerve. The trephine is now applied to the posterior wall of the antrum, and the bone having been removed, the ganglion will be most easily found by carefully tracing the nerve until its connection with the ganglion is reached. The latter may then be cut away with a pair of curved blunt-pointed scissors. Should there be troublesome hæmorrhage after the posterior wall of the antrum has been removed, pressure with the finger or with a pad of lint should be applied; the hæmorrhage is best avoided by taking great care not to lacerate with the trephine the soft structures posterior to the antrum.

The Inferior Dental Nerve.—Numerous operations have been practised for the exposure of this nerve. The following is the best:—The mouth being opened as widely as possible with a gag, an incision is carried along the anterior border of the ramus of the lower jaw, extending from the last upper molar to the corresponding tooth in the inferior maxilla. The mucous membrane being divided, the finger can be inserted between the internal pterygoid muscle and the ramus of the jaw. The muscle being pushed aside, the sharp spike of bone at the orifice of the inferior dental canal will then be the best guide to the nerve, which may be caught up as it enters the foramen by the backward sweep of a sharply curved aneurism-needle. Care is requisite to avoid mistaking the internal lateral ligament of the jaw for the nerve.

The Facial Nerve will be best reached by an incision extending from the lower part of the lobule of the ear forwards on to the ramus of the jaw. It quickly breaks up into its constituent branches.

The Spinal-accessory Nerve emerges from the posterior border of the sterno-mastoid, at a point a little above the middle of a line drawn from the clavicle to the mastoid process. It may be readily exposed at this point by an incision dividing the skin, platysma, and the deep fascia. Care must be taken not to mistake the superficial cervical nerve for the spinal accessory—the former curves forward round the sterno-mastoid, the latter runs in an oblique direction towards the back of the neck.

The Brachial Plexus is most easily exposed by an incision similar to that em-

ployed for the ligature of the subclavian artery—i.e. along the outer half of the clavicle. Lower down, the same nerve-trunks may be exposed by an incision carried down the middle of the axilla. Here also the *circumflex nerve* is most readily reached.

The Median Nerve may be exposed in the arm by an incision on the inner side of the biceps muscle; the nerve crosses the brachial artery in an oblique direction from without inwards. In the upper and middle part of the forearm this nerve is deeply situated, but at the wrist may readily be laid bare by an incision on the inner side of the palmaris longus tendon.

The Ulnar Nerve may easily be felt behind the internal condyle of the humerus. It may be reached in this situation by a longitudinal incision dividing the skin and fascia. In the forearm the nerve is deeply placed, but at the wrist may be reached by an incision on the outer side of the tendon of the flexor carpi ulnaris.

The Musculo-spiral Nerve is readily exposed by a longitudinal incision on the outer side of the limb, at a point midway between the external condyle of the humerus and the insertion of the deltoid. After the skin has been divided, the nerve may be easily felt to roll under the finger on the outer surface of the humerus; it should be cleared by separating the triceps from the biceps and brachialis anticus.

The Radial Nerve is easily accessible at the place where it passes from under the tendon of the supinator radii longus to the back of the wrist; here, by an incision on the posterior border of this tendon three inches above the wrist-joint, the nerve may be found, after dividing the skin and fascia covering it.

The Great Sciatic Nerve.—To define the course of the great sciatic nerve, draw a line from a point between the great trochanter and the tuberosity of the ischium, and half an inch nearer the latter than the former, to the middle of the popliteal space. The nerve may be exposed in the upper part of its course by an incision immediately below the gluteal fold, the biceps muscle being drawn inwards. If the incision be made below the middle of the thigh, the nerve will be found on the inner side of the same muscle.

The Internal Popliteal Nerve will be found, immediately beneath the deep fascia, in the middle line of the popliteal space.

The External Popliteal Nerve may be readily felt close to the inner side of the biceps tendon, covered by the skin and fascia.

The Posterior Tibial Nerve accompanies the artery of the same name down the back of the leg, its course being marked by a line drawn from the middle of the popliteal space to the hollow behind the inner ankle. In the upper part of the leg it is best exposed by an incision similar to that usually employed for ligature of its accompanying artery. At the inner ankle it will be found about a quarter of an inch behind this vessel.

The Anterior Tibial Nerve lies behind a line drawn from the front of the head of the fibula to a point midway between the two malleoli. The operation for its exposure does not differ from that for ligature of the anterior tibial artery.

The Musculo-cutaneous Nerve is easily reached by an incision just below the middle of the leg, in a line drawn from the front of the head of the fibula to the posterior border of the external malleolus. It will here be found emerging from the muscles on the outer side of the leg.

ANTHONY A. BOWLBY.

NEVILLE'S SPLINT. — Another name for **ARNOLD'S SPLINT**.

NIGHT-BLINDNESS. See **NYCTALOPIA**; **AMBLYOPIA**.

NIGRITIES. See **CHLOASMA**.

NIPPLE and **AREOLA**, Diseases of the.—**MALFORMATIONS.**—These may be congenital or acquired.—*Congenital Absence of the Nipple (Athelia)* is only met with in absence of the mamma. *Multiple Nipples (Polythelia)* are very rare, except in conjunction with multiple breasts. *Acquired Malformations.*—Complete destruction of the nipple has been met with as the result of burn. *Flattened Nipples* are not uncommon either from an error in development or from the pressure of the dress. This condition is of no importance unless the patient becomes pregnant. It may then be necessary, shortly before labour is expected, to raise the nipple by the occasional application of a small cupping-glass or a breast-pump, or by the suction of a strong infant or an adult. The parts must be bathed with warm water and gently manipulated. Violent dragging on the nipple, to 'draw the nipple-strings,' must of course be forbidden.

Fissures of the Nipple. Sore, Cracked, or Excoriated Nipple.—These occur during lactation. The causes are the constant moisture of the part, want of cleanliness, or the biting of the child. Thrush or

aphthæ in the child's mouth are variously asserted to be the cause and the effect of the sore nipple.

Symptoms.—The nipple swells and often assumes the form of a mushroom. It is at first red and excoriated, but not actually ulcerated. There is a slight serous or semi-purulent discharge. In the more advanced stages fissures form, radiating from the nipple into the areola. Their edges are raised and indurated, the floor is dark red and bleeds readily. Prominent granulations may project above the edges. The ulceration may extend, and even cause destruction of the nipple. The pain is excessive, the act of suckling becoming almost unbearable.

Treatment.—Sore nipples may be prevented by scrupulous cleanliness. The nipple should be frequently sponged with a concentrated solution of boracic acid, which, being tasteless, will not cause the child to refuse the breast. Brandy and water is often used for the same purpose. If a sore nipple threatens, an india-rubber shield should be used when the child is sucking. If a fissure forms the child must not be applied to the breast, but the milk must be drawn with a breast-pump. The following applications will be found useful. In the early stages, oxide of zinc and starch-powder; in the later, carbolic acid lotion (1 in 20), painted on twice a day; solid nitrate of silver occasionally to the fissure; Liq. plumbi f3ss., Sp. rect. f3j., Aq. ad Oj., applied on lint; boracic acid ointment. In some cases painting with flexile collodion gives relief. If the condition be neglected, abscess in the areola or mammary abscess may follow.

Eczema of the Nipple.—The nipple and areola are occasionally the seat of true eczema. The parts become red and tender, small vesicles form and burst, leaving a raw surface, from which an abundant serous discharge flows, often drying into crusts. There is much itching and uneasiness. Both nipples may be affected. It is most common during suckling, but is also met with as a part of general eczema, and more rarely as a consequence of scabies. It is very difficult to cure. The following are amongst the most useful applications:—Nitrate of silver lotion (gr. ij. to f3j.), with the occasional use of a stronger solution (gr. xx. to f3j.); lead lotion; calamine lotion; glycerine of borax; carbonate of lead ointment; zinc ointment. The extra-pharmacopœial remedies of most service are boracic acid lotion (concentrated solution), boracic acid ointment, boro-glyceride, glycerole of the sub-acetate of lead, and glycerole of lead

and vaseline ointment. Extract of belladonna, in the proportion of ʒj. to ʒj., may be added to these ointments.

So-called 'Eczema of the Nipple' as a precursor of Cancer.—Sir James Paget has called attention to a condition of the nipple closely resembling eczema, which he has observed to be followed by cancer in the gland after lasting from one to three years. The areola is in some cases intensely red, raw, and finely granular, 'like the surface in very acute diffuse eczema'; there is a copious yellowish discharge, which dries into scabs. It is accompanied by itching and burning sensations. In other cases the disease is more like psoriasis, the surface being covered with dry scales. As a rule, the morbid condition does not extend beyond the limits of the areola; occasionally, superficial ulceration takes place, ending in complete destruction of the nipple. The base of the ulcer is indurated. When cancer follows it is usually directly under the nipple, but there may be an interval of apparently healthy tissue between. The pathology of the disease has been accurately investigated by Mr. H. T. Butlin. He finds the following conditions:—Proliferation of the mucous layer of the epithelium and small-cell infiltration of the corium of the areola; dilatation of the galactopherous ducts, with proliferation of the epithelium, sometimes choking the lumen; small-cell infiltration around the diseased ducts; proliferation of the epithelium in the acini, and finally the extension of the epithelium into the surrounding structures. No treatment is of any use. Sir J. Paget considers it advisable to anticipate the development of cancer by removal of the breast, when this so-called eczema is met with in women about the age at which cancer is likely to develop, and more especially if there is a strong hereditary tendency to the disease.

Chancre of the Nipple.—Primary sores are occasionally met with in wet-nurses from the infection of syphilitic children. The mother is never affected in this way. *Mucous Tubercles* are sometimes seen on the nipple in secondary syphilis.

Abscess of the Areola is not uncommon in nursing women, especially in cases of sore or fissured nipple. There are the usual symptoms of redness, swelling, heat, and pain, followed by the formation of a small fluctuating swelling. The pus may burrow subcutaneously, but shows no tendency to extend deeply into the mamma.

Treatment.—As soon as the redness and swelling appear, the child must be removed from the breast and the milk drawn

with a breast-pump. Extract of belladonna and glycerine (equal parts) may then be painted on and hot fomentations applied. If this fails to arrest the formation of pus, the abscess must be opened, as soon as fluctuation is recognised, by a small incision radiating from the nipple.

MARCUS BECK.

NITROUS OXIDE GAS. See ANÆSTHETICS.

NOCTURNAL INCONTINENCE.
See INCONTINENCE OF URINE.

NODES. See PERIOSTITIS; SYPHILIS.

NOMA.—A term applied by old writers to Phagedæna of the Female Genital Organs, and also to Cancrum Oris. See CANCRUM ORIS.

NOSE, Diseases of the.—**CONGENITAL DEFORMITIES.**—The external parts of the nose may be entirely absent, an aperture alone being left, owing to suppression of the nasal process of the embryonic face, together with fusion of the eyes into one in Cyclopean fœtuses. Or the nostrils may exist as a couple of cartilaginous snouts without the support of nasal bones, orbital cleft and some defect of the eye usually coexisting.

The nose may be perfect on one side and malformed on the other, of which the writer has seen an instance. In a case seen by the writer, under the care of Mr. Chauncy Puzey, a male infant had a peculiarly broad, flattened, and grooved nose, owing to imperfect apposition of the nasal bones and septum, the effect of which was a deep median furrow, on the sides and floor of which the skin was stretched continuously, making manifest the character of the defect. Operative treatment has very much reduced the deformity.

OCCCLUSION of one or both nostrils may exist in front, while bony closure of the posterior nares may be found behind. As further instances of congenital deformity, a minor degree of one of the above deformities has been seen in the form of a fissure of the nostril and a narrowed fissure of the eyelids. The malformation in hare-lip, also, so far affects the nostril as to be worthy of incidental mention.

Treatment.—These defects are rare curiosities, but are sometimes susceptible of improvement by plastic operation, the plan of which in each instance will be devised by the ingenuity and common sense of the surgeon consulted.

ACQUIRED DEFORMITY.—Deformity of the nose may occur in after-life in consequence of injury or disease.

Total loss.—The nose may be cut off at a single blow, or may disappear, bones and soft parts, as the result of syphilitic necrosis and erosion. **Partial loss** may result from a less severe process of necrosis and ulceration in syphilis, or from the erosion of lupus.

Flattening of the nose may likewise result from the loss of the nasal bones by syphilitic necrosis, without affection of the external soft parts. A similar depression and flattening may follow bad fracture, without loss of the bony framework of the nose, which is here simply displaced.

Considerable lateral inclination of the nose, to even a grotesque extent, may result from fracture, or may exist without previous injury. A slight degree of deviation from the middle line is present in most people, and this is sometimes exaggerated in the case of long noses to the degree of caricature.

Treatment.—For total loss of the nose a reconstructive plastic operation may be undertaken, by dissecting an integumentary flap of suitable shape from the forehead (the Indian method) or from the upper limb of the patient. In the latter, the method of Tagliacotius, the arm is immovably attached to the head, where it has to be maintained during union of the flap. For partial reconstruction of an ala or other portion of the nose, a plastic operation on a smaller scale is effected by taking a flap from the cheek. Such procedures are only admissible after entire soundness of the tissues has followed the disappearance of all trace of ulceration and inflammation, and their results are not satisfactory. For their detailed execution, see the article on RHINOPLASTY. An artificial nose of enamelled silver, supported by a spectacle-frame, is probably more successful in restoring the natural appearance of the face. To prevent or correct the deformity that may result from fracture, see the next paragraph.

INJURIES OF THE NOSE.—**Fracture of the nose**, the result of blows or violent falls, is sometimes attended with much disfigurement, owing to ecchymosis and swelling of the integuments. Through this, however, the fracture of the nasal bones or septum may be recognised by mobility, crepitus, or alteration of shape.

The depressed or displaced state of the fractured bones is apt to be perpetuated as a deformity, owing to the rapidity with which union takes place. Depressed nasal bones should, therefore, be at once elevated under chloroform by strong forceps covered

ith wash-leather, by means of which also the septum can be straightened. A splint of collodion and lint may be made to support the bridge of the nose, and it may sometimes be necessary to plug one of the nostrils.

A plan of treatment, recommended by the writer, consists in waiting a day or two until the chief tenderness has gone, ointments or cold applications being employed in the meanwhile if apparently required, after which the systematic manipulation of the nose is frequently practised every day, beginning before the end of the first week. It does not matter how great the immediate deformity at the time of injury, so that the nose be not permitted eventually to acquire a bad shape. This daily manipulation will effect the ultimate acquisition of any shape that may be desired, even to the improvement of a nose which, before the injury, may have been ill-shaped. The greater part of this daily fingering can be done by the patient under the superintendence of the surgeon, who inspects from time to time, and makes suggestions as required.

Wounds of the nose, operative or accidental, should be closed by the neat application of sutures, when not attended by great loss of skin or excessive bruising of the cut edges. In the latter event the injury should be left to granulate, and be suitably dressed with an antiseptic ointment, supplemented by washing with warm antiseptic lotions.

Foreign bodies are introduced by children through the nostril for the amusement of passing them back and ejecting them by the mouth. Such objects as peas, beans, buttons, pencils, bits of rolled paper, cabbage-leaf, &c., serve for the experiment, which, whether self-inflicted or vicariously performed, now and then fails, and the object sticks.

The removal may be easy or difficult according to circumstances. In the event of much pain and tenderness, and restiveness on the part of the child, the difficulties may be great without an anæsthetic. For extraction forwards by the nostril, a pair of slender-beaked forceps, toothed at the end, will answer the purpose. In easy cases, ordinary dissecting-forceps may answer. Or the object may be pushed back and ejected by the mouth, care being, if possible, taken that it be not swallowed, or, what is worse, admitted into the glottis or trachea.

Blood-tumour of the septum may occur in association with fracture, and its spontaneous disappearance may usually be

looked for. *Acute abscess* of the septum may follow fracture or blood-tumour. The treatment is incision in one nostril, with excision of a fragment of cartilage, at the margin of the opening thus made, to further drainage. See SEPTUM NARIUM, Affections of the.

DISEASES OF THE SKIN OF THE NOSE.—Persons of bibulous habits, more especially men, sometimes become the subjects of what is called 'bottle nose,' in which the nose, with or without the adjacent portions of the face, is reddened, congested, and irregularly swollen. This appearance and convivial habits are often combined; but the same appearance may now and then be found in abstemious persons (see ACNE ROSACEA).

Lipoma nasi is a peculiar enlargement of the nose, greatly resembling in shape that of some true 'bottle noses.' This affection is nothing more than a chronic inflammatory hypertrophy of the nasal integument, and is remediable by operation. The thickened masses of skin are carefully dissected off the nasal cartilage, the latter being protected by a finger kept within the nose. The greater part of the excrescence should be removed, but it is not necessary to excise every fragment of thickened skin. The resulting sore granulates up under appropriate dressing, and the thickened fragments atrophy in the process of healing. No 'cosmetic' operation is better worth the undertaking.

Little warts, pimples, or congenital dermoid tumours (moles) may be situated on the nose, but are commonly not interfered with, though their removal would often improve the appearance of their possessor. The skin of the nose may also be the seat of adenoma—a rare affection, however, in this situation.

Epithelioma may occur at the tip and orifice of the nose in old persons. The writer has seen two cases, of which one was excised successfully with the cartilage of the organ. A deformity was left, but in some cases plastic reconstruction might be done. In the other case the feeble health of the patient did not permit operation, and the disease ran its course.

Rodent ulcer is more common than epithelioma, and although usually met with in old age and middle life, it sometimes occurs at an earlier period. It usually attacks the ala at first, when, from being a scabby excoriation, it becomes a small chronic ulcer, having a circular or irregular shape, with a slight induration round the margin. Excision well beyond the margin

and floor of the ulcer should be practised. See CARCINOMA; ULCERS.

Lupus is a chronic inflammatory affection of the skin, occurring, as far as the nose is concerned, in youth and early adult life, mostly in the female sex. The disease presents various distinctive appearances and effects.

The nasal integument covering the cartilage, chiefly at one of the alæ, becomes scabby superficially, and covered with granulations beneath. This may exist without loss of shape, the organ simply presenting the condition of a chronic sore. A severer degree consists in a gradual erosion of the tissues, including the cartilage, beneath the superficial coating of granulations, from which serum and pus exude, drying into scabs. The term '*lupus exedens*' is applied to the severest cases of deforming lupus.

The *diagnosis* is chiefly a question of age. All flabby ulcerations of the nasal skin, which do not heal spontaneously or speedily in young persons, are varieties of lupus, the recognition of which is rendered more certain if occurring in persons of an obviously strumous habit, though it often occurs without assignable cause or constitutional taint. Chronic ulcerations of inveterate character in the same situation in middle life, and not amenable to anti-syphilitic treatment, are almost sure to be rodent ulcer.

Treatment.—The early appearances of lupus, before erosion has become apparent, may be so mild and restricted as to mislead the observer into a reliance upon weak lotions and ointments, under the impression that healing is likely to be promoted. Even an occasional application of caustic substances, with temporary improvement, is apt, without perseverance, to dishearten or disgust both the patient and the practitioner. The tissues which are morbidly affected require to be removed, and this is best effected by scraping them away. A blunt knife, or a Volkmann's sharp spoon, will do this best. The same effect may be produced by rubbing the granulations into a pulp with chloride of zinc, or nitrate of silver, sulphate of copper, potassa fusa, &c.; by freely treating them with nitric acid, acid nitrate of mercury, and other strong liquids; or by burning them with the red-hot iron, Paquelin's thermo-cautery, and the like. All these methods, if thoroughly and repeatedly used, accomplish the same object, that of removing from the surface of tissues still healthy, the baneful influence of tissues hopelessly diseased and exerting a chronic contagious effect if left

behind. Any general constitutional management, such as the selection of a diet suited to the existing strength and digestion of the patient, and attention to essential comfort, may be required in lupus, as an incidental part of the treatment. See LUPUS.

DISCHARGES FROM THE NOSE.—Nothing is more common, at all ages, than the occurrence of a watery discharge on exposure to wet or dry cold. The effect may be quite transitory if the cause be not much prolonged. Some persons are extremely sensitive, and are affected with running at the nose on slight provocation of the above nature, and liable to severe and protracted catarrh if the cause of the preliminary running be maintained. The discharge then becomes thicker from secretion of mucus, which eventually may become purulent. Much inconvenience, a certain degree of illness, and generally frontal headache, attend severe nasal catarrh, which invades the frontal sinuses as well as other extensions of the nasal mucous membrane. The disease is believed to be frequently a constitutional infection as well as a local catarrh, and its simultaneous or consecutive appearance in persons living or associating together leads to severe '*coryza*' and '*influenza*' being regarded as somewhat '*infectious*.' Warmth and nursing are the utmost required for treatment, which is more generally omitted altogether, as most people in this climate are accustomed to perform their duties whether thus affected or not. Some believe they can cut short a cold at the very commencement by the prompt and frequent use of a snuff containing nitrate of bismuth and morphia in powder. In severe chronic catarrh, the use of the NASAL DOUCHE is most agreeable and also useful. It is preferable in the form of cold water, to which may be added a trace of common salt, chloride of zinc, borax, boracic acid, or chlorate of potash.

Chronic Coryza is a common symptom of inherited syphilis in childhood and infancy. An acid sero-purulent discharge fills the nostrils and reddens the skin at the orifice by irritative contact. The nasal douche is here invaluable. If this local washing be not speedily effectual, the internal administration of mercury (if it has not previously been otherwise necessary) must be resorted to. The most convenient mode is in the form of grey powder, one-third or half a grain at a time, once, twice, or thrice a day. See RETRO-NASAL CATARRH.

OZENA is the name given to a more intractable nasal discharge, muco-purulent

character, attended with much fetor, associated with syphilis, especially the inherited form, and almost always a sign of ulceration of mucous membrane and necrosis of bone in the nasal cavity. Depression of the nose and notched edges to the upper incisor teeth, when present, reveal at a glance the constitutional features of the local malady.

The nasal douche, with solution of chloride of zinc, one-eighth of a grain to the ounce, frequently and persistently used, is all-essential for treatment, and may be necessary, in the first instance, to remove the abominable smell, and otherwise facilitate the examination of the patient.

In adults suffering from tertiary syphilis, a similar condition will be found attending necrosis of the bones inside the nose, and multiple ulceration of that cavity and of the palate and mouth. Here also the nasal douche, medicated as above, is a source of daily comfort and satisfaction to the patient. But the internal administration of mercury, as grey powder, one grain at a time, given thrice, twice, or once a day, will suffice to promote sound healing, when supplemented by removal of loose pieces of necrosed bone.

NECROSIS OF THE BONES lining the nose most commonly occurs in syphilitic persons. In adult life it is usually the tertiary degree of acquired syphilis, while in children or adolescents it is the inherited form of the disease. At first, gummatus tumours form in the submucous tissue and periosteum, chiefly of the palate, and if the disease continue untreated, the gummy tumour or tumours burst, decomposition ensues, and progressive ulceration of the soft parts, with baring of the bone and its necrosis takes place. The disease is seldom confined to the nose or mouth, but is commonly shared by both cavities.

Fetor, purulent discharge, with a sense of exposed bone on using a probe or director passed into any aperture in the mucous membrane of the palate or nostrils, will reveal the condition of things, and enable the surgeon to feel whether the bone be loose enough for detachment.

Treatment.—Introduce a pair of dressing- or sequester-forceps and extract any pieces of loose bone that readily move, if the mucous apertures be wide enough for the purpose. This may frequently be done simply, speedily, and with no more pain than many patients are willing to bear. In the event of great tenderness, or any difficulty in at once extracting the bone, place the patient under an anæsthetic, and

enlarge such apertures as require it and seem most convenient for extraction. Be prepared, in the event of much bleeding (for it is sometimes very profuse), to employ vigorously the hot douche with a Higginson's syringe, by which means it can be quickly applied and the bleeding speedily stanchied. *See* ROUGE'S OPERATION.

For after-washing, chloride of zinc in tepid water, an eighth of a grain to the ounce, or a grain to the pint, may be used. If there be other gummata arising, or persistent ulceration of the soft parts, the use of washes and lotions will not be sufficient, however assiduously employed. But a grain of grey powder in the adult, and a third or half a grain in the young, given thrice, twice, or once a day, will procure eventual healing.

RUSHTON PARKER.

NURSING. *See* SICK-ROOM, Management of the.

NYCTALOPIA. — Night-blindness. Often, but incorrectly, used to denote *day-blindness* (Hemeralopia). *See* AMBLYOPIA.

NYSTAGMUS.—This name signifies an involuntary and more or less constant oscillation of the eyes. The movements are, in nearly all cases, bilateral, similar, and synchronous in the two eyes. They accompany, and do not impede or otherwise affect the normal voluntary movements. In different cases they vary much in direction, velocity, and amount, and, in the same case, they usually vary to some extent with the position of the eyes and head, and with the patient's state of mind, being increased by nervousness or excitement.

Causes and Pathology.—The oscillations of the eyes are, probably, the expression of abnormal action in the centres which preside over the ocular movements. In a large majority of cases, the affection occurs in association with some imperfection of vision dating either from birth or from very early infancy, such as congenital amblyopia without ophthalmoscopic changes, congenital defects in the discs, microphthalmos, high degrees of refractive error, albinism, congenital cataract, corneal opacities left by purulent ophthalmia in the first weeks of life, and so forth. In these cases, the disordered movements may reasonably be attributed to the absence of normal visual impressions, and the consequent want of stimulus to fixation, at the time of life when the centres for ocular movements are normally developed and trained. In the uncommon cases in which a congenital nystagmus goes with

normal or nearly normal vision, an independent defect in the development of these centres must be assumed. The affection sometimes shows a remarkable tendency to hereditary transmission; thus it was ascertained in one instance (Lloyd Owen, *Ophthalmic Review*, vol. i. p. 289) to have been present in nine individuals belonging to four generations, and to have been transmitted in such a manner that the male children of the female members of the family were the only ones affected, the females themselves being entirely exempt. Beyond a general prevalence of hypermetropia, no family ailment, nervous or otherwise, was discoverable; the nystagmus was present from birth, and persisted unaltered throughout life.

Nystagmus is met with as an acquired disease amongst *coal miners*, especially affecting those who have to work in a stooping, cramped position, or lying on the side. The cause of the affection, in these cases, is no doubt, to some extent, analogous to that already indicated. The miner works between black walls with a very feeble light; the stimulus to fixation is reduced to a minimum, while at the same time the necessity for constantly turning the eyes strongly upwards or to one side, in consequence of the position above referred to, makes an excessive demand upon the energy of the nerve-centres. Perverted action is the consequence. The effect of a stooping position, in increasing or inducing the oscillations of the eyes, is sometimes very evident on clinical examination in cases of miners' nystagmus. Lastly, nystagmus occurs, occasionally, as the result of injury to the head and in cases of disseminated sclerosis, in which conditions the disturbance in the brain-

centres must be assumed to be altogether independent of ocular conditions. The commonest form of nystagmus is that in which the excursions of the eyes are horizontal, the least common that in which they are purely vertical. Oblique movements and rotatory movements around the antero-posterior axis are not uncommon. In the congenital variety, the patient is not, as a rule, troubled by any appearance of oscillation in the objects at which he looks, while in the acquired forms it is often otherwise, and the dancing of objects before the eyes may render work impossible. Although the will has usually no direct influence in causing or arresting the movements, the patient often acquires the habit of keeping his head and eyes in the particular position in which the movements are smallest; in some cases they cease entirely during strong convergence. In a few cases the head also makes continuous oscillatory movements; whether these latter are ever of a compensatory nature is doubtful.

Treatment.—In all cases of congenital nystagmus, an examination should be made as to the cause of the amblyopia which underlies it. In some, an operation for cataract will be indicated; in others, the correction of high refractive errors; while, in the absence of both these faults, blue glasses will sometimes be found to increase the acuity of vision and lessen the nystagmus. In miners' nystagmus, a total discontinuance of underground work, together with iron and strychnia, has in many cases effected a cure, partial or complete; the removal from the mine is the essential step, and a return to it, at any future time, is likely to bring about a return of the nystagmus. PRIESTLEY SMITH.

O

OBTURATOR ARTERY.—This vessel normally arises from the anterior division of the internal iliac artery, runs along the side of the pelvis, passes through the groove at the upper part of the obturator foramen, and dividing into two, embraces the fleshy origin of the obturator externus muscle. In the proportion of 1 in 5 cases, however, the vessel arises from the deep epigastric, and drops down into the pelvis to reach the obturator foramen; in this course it is in relation with the upper

end of the crural canal—the crural ring. In about one-third of the number of cases met with, the artery passes in contact with the femoral vein, and hence to the outer side of the ring; in the remaining instances the artery encircles the ring. It is this latter position which renders the artery surgically important, as in it the vessel may be cut when an incision is made to relieve the constriction in femoral hernia. The former variety is called the safe, the latter the unsafe, abnormality of the vessel.

To prevent wounding the vessel, a blunt-pointed knife should be used to incise the constriction. If it should happen that the artery is wounded, one or other of the following methods may be adopted to stop the hemorrhage:—

(1) Compress the bleeding point for five minutes between the finger and thumb.

(2) If this is insufficient, enlarge the wound slightly and tie or twist the bleeding point or points.

(3) If neither avail, pass a threaded needle around the bleeding point and tie it.

(4) If no other means avail, make an incision as for ligature of the external iliac, and reach the bleeding point by pushing aside the peritoneum. JAMES CANTLIE.

OBTURATOR HERNIA.—The rupture escapes through the obturator canal. This canal is placed at the upper and outer part of the thyroid foramen, and is directed from behind forwards and inwards. The hernia pushes in front of it the fascia covering the obturator externus muscle, and perhaps, also, a few fibres of that muscle. It appears on the surface beneath the pectineus, with which muscle its fundus is covered. The tumour is above the adductor brevis, is behind and to the inner side of the femoral vessels, is to the outer side of the tendon of the adductor longus, and to the inner side of the capsule of the hip. The neck of the sac is in the obturator canal. It would appear that the obturator hernia is found with equal frequency to the inner and to the outer side of the neck of the sac. In about one-fifth of the reported cases it has been found behind it. The contents are usually small intestine, without some omentum. In one recorded instance a part of the bladder occupied the rupture. This form of hernia is, as a rule, met with in females of from forty to fifty years of age.

It is doubtful if the rupture, when of its ordinary size, can be diagnosed unless it be the seat of some acute change. The tumour is nearly always very small—so small that it causes but a very indistinct swelling beneath the pectineus muscle. Strangulation has frequently occurred in this hernia, and the rupture, when so circumstanced, has been reduced both by taxis and by herniotomy.

When the rupture is strangulated, there will be the usual symptoms of that condition, together with an absence of signs of strangulated hernia in any of the usual situations. Beneath the pectineus muscle there is a small, hard, tense tumour, which

is the seat of some pain, is tender and dull on percussion. There is pain on moving the hip, especially when it is moved actively. Pain may be complained of along the course of the obturator nerve. It is said that the neck of the sac has been felt and recognised through the vagina.

In applying the taxis, the thigh should be flexed, adducted, and rotated a little outwards. The pressure should be applied in a direction from before backwards, with a slight inclination outwards, so as to correspond with the line of the obturator canal.

In performing herniotomy, an incision from two to three inches in length is made over the tumour, parallel to the femoral vessels, and about one inch to their inner side. The fascia lata is exposed and divided, and the pectineus muscle is laid bare in the incision. The muscle is incised vertically in the line of the original incision, and the fundus of the sac will be exposed.

The stricture will be found at the neck of the sac in the obturator canal. The director must be introduced on the inferior aspect of the neck, and the stricture divided by cutting, either directly downwards, or downwards and a little outwards.

FREDERICK TREVES.

OBTURATORS. See CLEFT PALATE, The Mechanical Treatment of.

OCULAR MUSCLES, Affections of the.—The mechanism presiding over the movements of the eyes consists of three distinct parts: the muscles attached to the outer surface of the globe; the nerves, which convey impulses to the muscles; the brain-centres, in which the impulses originate. A clear conception of the way in which this complex mechanism acts must be gained, before the various symptoms which indicate disturbance of it can be understood. Within certain limits imposed by its attachments, each eye can be moved in all directions around an imaginary point situated about 2 mm. behind the centre of the globe. When the head is upright, and the eyes look straight forward at a distant object—i.e. when the visual axes are perpendicular to the plane of the face—the eyes are said to be in their primary position.

MUSCLES.—Reckoning from the primary position, the action of the individual muscles is as follows:—The internal rectus turns the eye directly inwards. The external rectus directly outwards. The superior rectus chiefly upwards, but at the same time a little inwards, causing a slight inclination of the vertical meridian of the cornea inwards

(towards the median line above). This twisting action depends on the fact that the optic foramen, from the margin of which the muscle takes origin, lies not directly behind the eyeball but a little nearer to the median line of the skull. The inferior rectus chiefly downwards, but also slightly inwards, with an inclination of the corneal meridian outwards, for the same reason as in the foregoing case. The two oblique muscles send their tendons, not from behind forwards like the recti, but rather from side to side; their chief action, therefore, is to twist the globe upon its antero-posterior axis; but as they do not lie parallel with the equator, but pass to their insertions somewhat from before backwards, they also move the eye in oblique directions intermediate between the horizontal and the vertical. Thus, the superior oblique turns the eye downwards and outwards, and inclines the vertical meridian of the cornea inwards; it acts together with the inferior rectus, and counteracts the twisting action of the latter. The inferior oblique turns the eye upwards and outwards, and inclines the vertical meridian of the cornea outwards; it acts together with the superior rectus, and counteracts the twisting action of the latter. When the eye stands in any position other than the primary, the actions of the individual muscles are somewhat modified, for the directions in which they pull are altered in relation to the chief axes of the eye. In simple upward, downward, and horizontal movements from the primary position, the vertical meridian of the cornea remains vertical, but in oblique movements it becomes slightly inclined in the direction of the movement; thus, when the eye is turned upwards and to the right, the meridian of the cornea is inclined slightly, its upper end being towards the right, and so on for other movements of like kind.

NERVES.—The ocular muscles are actuated by three pairs of nerves. The third nerve (motor oculi) supplies all except the external rectus and the superior oblique; it also supplies the levator of the lid, the sphincter of the iris, and the ciliary muscle. The sixth nerve (abducens) supplies the external rectus. The fourth nerve (trochlear) supplies the superior oblique.

BRAIN-CENTRES.—In the substance of the brain, the fibres which are contained in the nerves above named undergo rearrangement and partial decussation. They are connected largely with the gray matter of the corpora quadrigemina and its vicinity, and with higher volitional centres in the cortex; the co-ordination in these centres

appears to be such that all impulses issued to the ocular muscles take effect bilaterally, producing harmonious movements of the two eyes together. The necessity for such co-ordination lies in the fact that, in every normal act of vision, the object looked at is pictured on corresponding points of the two retinæ. The centres are complex as regards their anatomical relations and functions, and are not yet completely made out. The following are those of which we have the most definite physiological evidence:—(a) A centre in the right side of the brain, which combines fibres from the internal rectus of its own side with fibres from the external rectus of the opposite side, and thus produces movement of both eyes to the left. (b) A centre on the left side, which in like manner turns both eyes to the right. (c) A centre which actuates both internal recti, producing movements of convergence; it is closely associated with another centre, which actuates the two lower recti and turns both eyes downwards, and also with others which govern the sphincters of the iris and the ciliary muscles in both eyes, producing contraction of the pupils and accommodation. (d) A centre which receives fibres from the two external recti and produces movements of divergence, or rather of diminished convergence. As will be seen later, there are many forms of disturbance of ocular movements which can only be explained by reference to these compound or associated centres.

The conditions which disturb the movements of the eyes are numerous, and of very different kinds, namely:—(1) Adhesions between the globe and the eyelids, effusions and new formations in the orbit, and even faults in the shape of the eyeball itself, which in a mechanical manner oppose or limit the excursions of the eye in certain directions; (2) faults in the muscles, due to malformation, injury, or to the tissue-changes which occur as the result of excessive or deficient nerve-stimulus; (3) lesions of the nerves at various points between their origin in the brain and their distribution in the muscles; and (4) conditions which disturb the action of the brain-centres. It is evident that any single lesion or fault belonging to either of the first three classes will affect the movement of one eye only, and will throw it out of harmony with its fellow whenever the impaired movement is attempted; the commonest affections of this kind are the paralyses of the ocular nerve-trunks. On the other hand, any condition belonging to the fourth class, whether it be merely a functional overaction, as in

the squint of the hypermetrope, or a suspension of action through a paralyzing lesion, as in the conjugate deviation of hemiplegia, will produce ocular symptoms which are essentially bilateral. So far as they move at all, the two eyes still move in company with each other; to all affections of this class, therefore, the term *concomitant* may be applied. Before discussing these different affections in detail, it will be convenient to speak of certain phenomena which are common to several of them.

DEVIATION OF THE EYE.—In health, the eyes are invariably so directed that the object looked at is pictured on the yellow spot in each retina. If either eye is directed otherwise, it is said to deviate or squint; it has a strabismus. The commonest forms of strabismus are those in which the optic axes converge too much, or diverge, and the same is applied especially to the concomitant varieties—to those, namely, which are produced by excessive or defective action of the centres for convergence and divergence, rather than to deviations due to paralyzing lesions of nerve-trunks; but it applies strictly to the latter also. A less common form of deviation is that in which both eyes are turned involuntarily towards one or the other side, in consequence of a loss of equilibrium in the centres which preside over conjugate movements. See STRABISMUS.

DIPLOPIA OR DOUBLE VISION.—Under certain exceptional conditions, objects are seen double by one eye used alone (monocular diplopia, polyopia); here the fault lies in the refraction of the eye, not in its position. Such cases have no connection with our present subject. In binocular diplopia the two images belong to the two eyes respectively, and when one eye is covered one image disappears.

Double vision indicates a deviation of one or other eye. The image seen in the wrong position belongs to the deviating eye, and is termed the false image; it is usually fainter than the true image because it is formed, not at the yellow spot, but at a less sensitive part of the retina; hence, so, the greater the deviation of the eye, and the greater the consequent displacement of the false image, the fainter does the image become. On this account, the confusion and giddiness produced by double vision are usually greater when the deviation of the eye is slight and the images near together, than when they are widely separated; in the latter case, and, indeed, in most cases of long-standing deviation, the false image is suppressed, the mind

taking no cognisance of the second and erroneous impression. The relative positions of the two images give valuable and very precise indications as to which is the deviating eye, and as to the direction and amount of the deviation. The following rule holds good in all cases:—*The false image and the cornea are displaced in opposite directions.* The reason of this will appear from the following considerations.

We judge of the position of objects from the position of their pictures in our eyes; but, in order that the judgment shall be true, we require to know the position of our eyes. Of this latter we are informed by the muscular sense—in other words, by the amount of the impulse issued by the brain-centres to the muscles. Now if, from any cause whatever, either eye fail to respond correctly to the impulse issued by the brain, we misjudge its position, and, as a consequence, we misjudge the positions of objects pictured on its retina; we project the retinal images as though the eye stood in its right position. For example, supposing the right eye to deviate to the right, while the left eye, obeying the impulse of the will, looks straight forwards at an object directly in front of it. As the cornea of the deviating eye moves outwards, the retina of course moves inwards, so that in this eye the object is pictured on the outer half of the retina instead of at the yellow spot. But if the eye were in its right position, this part of the retina would correspond in direction with objects lying to the patient's left, hence, with this eye, which deviates to the right, he sees things displaced to the left. If, therefore, in any case of doubtful nature, we can ascertain what is the position of the false image in relation to the true image, we shall know what is the direction of the deviation of the corresponding eye. Thus, if the images are crossed in regard to their respective eyes, we know that the deviation is of the opposite kind—namely, one of divergence; if the images are homonymous (each standing to the side corresponding to its own eye), we know that the axes of the eyes are crossed; if the image, instead of standing vertical, appears inclined to either side, we know that the vertical meridian of the corresponding eye is inclined in precisely the opposite direction.

In studying the positions of the double images, we cause the patient to look steadfastly at an object, such as a slip of white paper or a lighted candle, with both eyes open; then, covering each eye alternately,

and telling him to keep looking at the object with the other, we ascertain which eye was properly directed and which was deviating. By causing him to follow the object with his eyes in different directions, we learn in which direction the images separate most widely, and in which they come nearest together; and thereby ascertain in which particular movement the error is greatest, and which muscle is at fault. If the distance between the two images is constant in all positions of the eyes, we know that the affection is of the concomitant form and is not due to a fault in any individual muscle or nerve. A coloured glass placed in the trial spectacle frame before one or other eye, so as to colour the corresponding image, makes the examination easier; it should be placed by preference before the eye which looks straight at the object, for the image seen by the deviating eye is already somewhat the fainter of the two, and, if its intensity be still further lowered by the interposition of the coloured glass, it may probably be altogether overlooked.

Diplopia may be produced in a person with healthy eyes by means of a prism. Rays of light passing through a prism are deflected from their course; hence a prism held before the eye displaces the image of the object looked at on to a part of the retina other than that on which it would naturally fall, and hence double vision. Conversely, diplopia may be corrected by a prism so placed as to counteract the displacement of the image due to the deviation of the eye. A prism deflects rays towards the side corresponding with its own base, and since the actual displacement of the retinal picture in a deviating eye is the opposite of the apparent displacement of the false image in space, the correcting prism must be placed with its base towards the same side as the false image; or, to put the matter simply, let the thick edge of the prism be over the weak muscle. The strength of the prism which corrects the diplopia serves as a measure of the deviation of the eye.

DISEASES AND INJURIES OF THE OCULAR MUSCLES.—These, as distinguished from paralyzes due to nerve-lesions, are not common. In rare instances, one or more of the muscles may be congenitally wanting; in others, abnormal adhesions of the muscle among themselves have been noted; clinically, an accurate diagnosis of such conditions is not possible. Perforating wounds, near to the eyeball, may damage one or other of the muscles so as to permanently impair or annihilate its action; an improperly

performed operation of tenotomy for squint may do the same. The deviations thus produced may frequently be remedied by surgical readjustment of the damaged tendon. See STRABISMUS. Occasionally, by violent injury with a hook or similar object, a muscle is torn away from its posterior attachment, as in a case, seen by the writer, in which a young man jumping over a table came in collision with a gas-burner, which tore the upper eyelid and the ocular conjunctiva, and dragged out the greater part of the internal rectus. Morbid contracture of a muscle occurs as a result of prolonged excessive effort, as in the strabismus of hypermetropia, and loss of tone in the antagonistic muscle, as in paralytic strabismus.

PARALYSIS OF THE OCULAR MUSCLES.—*Causes and Pathology.*—In a large majority of cases, these paralyzes correspond with the distributions of the third, fourth, and sixth nerves. In order of frequency, paralysis of the group of muscles supplied by the third nerve probably stands first; next, and nearly as frequent, paralysis of the external rectus (sixth nerve); lastly, and considerably less frequent, paralysis of the superior oblique (fourth nerve). Isolated paralysis of one of the muscles supplied by the third nerve is comparatively rare; it indicates lesion in a separate branch of the nerve, or in the muscle itself. Syphilis, rheumatism or chill, and injury are the commonest causes of these paralyzes. It is chiefly in the later stages of acquired *syphilis*, much less commonly in the hereditary disease, that they, and especially the third-nerve paralysis, are met with. The lesion may be within the skull, in the sphenoidal fissure, or in the orbital portion of the nerve. Whether it is most commonly of the nature of a gumma, a meningitis, a periostitis, or an inflammation of the connective tissue of the nerve itself, is uncertain. As in the following form, chill to the surface is not infrequently concerned in lighting up the mischief. *Rheumatism* in its acute febrile form is rarely associated with ocular paralysis, but the rheumatism, so-called, which occurs locally, as the result of cold or damp to the surface, is very frequently so. *Gout* must certainly be included as a predisposing cause, for it is especially in those who are immoderate eaters and drinkers, and who show signs of lithiasis, that exposure to cold acts in this way. *Diphtheria* is frequently followed by paralysis of the ciliary muscles (loss of accommodation), less often by paralysis of the external muscles of the eye. *Injuries*

of the skull, especially such as involve fracture of the base, extravasation of blood, meningitis, tumour, abscess, aneurism of the basilar arteries—in short, all changes within the skull which, by pressure or otherwise, can interfere with the nerves at the base of the brain, may paralyse the ocular muscles. Lesions of the nerve-fibres in the substance of the brain are likely to cause paralysis of bilateral form, rather than such as can be referred to one or other of the nerve-trunks. Transient paralyses of the ocular muscles are frequent during the earlier stages of *locomotor ataxy*; the nature of the lesion is uncertain; it is not in direct connection with the changes in the spinal cord.

Symptoms and Diagnosis.—Paralysis of an ocular muscle reveals itself by symptoms which are definite, and can be studied with precision. Movements requiring the action of the paralysed muscle are impaired or lost. We tell the patient to follow the movement of a finger passed in different directions before him, his head being kept in a fixed position, and we notice that while one eye moves to the usual extent upwards, downwards, and to each side, the other is unable to accompany it in a certain direction. Covering the unaffected eye, we then bid the patient do his utmost to follow the finger in this direction, and we find that there is a point beyond which his strongest effort fails to move the eye. The precise position of this point depends upon the completeness or incompleteness of the paralysis, and upon whether movement in the said direction depends solely upon the muscle which is paralysed, or is aided by others.

The eye deviates away from the paralysed muscle. The unaffected eye being in the primary position—that is, looking straight forward at a distant object—the affected eye, although no special effort is demanded of the paralysed muscle, deviates somewhat in the direction of the opponent muscle, the tonic contraction of the latter overbalancing the weakened tonicity of its antagonist. The deviation of the affected eye is called the ‘primary deviation.’ It increases when the patient looks in the direction which demands the action of the paralysed muscle, and decreases when he looks in the opposite direction. It is increased, in cases of long duration, by an actual shortening of the opponent muscle. Again, telling the patient to look at the distant object as before, we bring a hand or a piece of paper in front of the sound eye. By a strong effort, the patient

then brings the affected eye to bear upon the object, and at the same moment the sound eye, moving in the same direction behind the paper, takes up the deviation. This deviation of the sound eye, when the affected eye fixes, is called the ‘secondary deviation;’ it is greater than the primary deviation, for the brain-centre takes no cognisance of the nerve-lesion, and issues an equal impulse to the two sides as in health. Under this impulse the normally innervated muscle acts vigorously, while the paralysed muscle acts feebly.

With both eyes open the patient sees double. This is true, of course, only when the patient actually sees with both eyes; any defect in the visual power of the deviating eye promotes the suppression of the false image. If it should happen that the deviating eye has decidedly the better vision of the two, the patient will contrive by a compensatory position of the head to bring this eye to bear upon the object at which he desires to look; and if the affected muscle be only partly paralysed, a strong impulse will be issued to this muscle, and consequently a secondary magnified deviation of the fellow-eye will be induced, and we shall have the phenomenon of a patient looking straight with a paralysed eye and squinting with a non-paralysed eye. As a diagnostic symptom, *double vision* is of value only when the nature, or the existence, of a deviation would otherwise be uncertain. In paralysis of the fourth nerve, for example, it enables us at once to make a diagnosis, which would otherwise be hardly possible. It also enables us to measure the amount of a deviation, and to accurately judge of its progress towards recovery. The laws which it follows have already been explained. See *Diplopia*. In cases of very slight deviation of the eye, there may be only a confusion or unsteadiness of sight due to an overlapping of the two images, rather than a true diplopia; or diplopia may be elicited only by causing the patient to turn his eyes strongly in the particular direction in which the weakened muscle acts. In many cases the complaint made is rather of giddiness than of double vision, and this is attributable to the patient’s inability to estimate, with certainty, his position in relation to surrounding objects, and especially in relation to the plane of the ground on which he walks.

To avoid the double vision and the giddiness which goes with it, the patient frequently keeps his head turned in a direction which neutralises the deviation of the eye. Thus, if the right eye deviate towards

the right, he will turn his face round towards the left, so that, in looking before him, he may turn the left eye also towards the right, and thus restore parallelism between the two. Or he will adopt the simple expedient of keeping one eye closed; the closed eye will, in most cases, prove to be the paralysed eye, but should this latter have the better vision of the two, its services may be retained, while the other is excluded for the sake of avoiding double vision. Ocular paralysis often declare themselves to the observer, at first glance, by these peculiar positions of the head. The distinctive symptoms of the several varieties of paralysis of the ocular muscles may now be stated briefly; they will be understood by reference to the distribution of the nerves and the general symptomatology already given.

THIRD-NERVE PARALYSIS.—Ptosis, drooping, or complete falling of the upper eyelid; loss of the inward, upward, and downward movements of the eyeball, discoverable on raising the lid and bidding the patient to follow the movements of a finger in various directions. Deviation of the eye outwards, through unopposed action of the external rectus, the deviation being neutralised when the sound eye looks towards the paralysed eye, increased when it looks away from it; also a slight deviation downwards, through unopposed action of the superior oblique. Double vision, when the lid is raised, the images being crossed—i.e. the image belonging to the right eye standing to the left, and *vice versa*; dilatation of the pupil; loss of accommodation. When downward movement is attempted, a slight twisting on the antero-posterior axis, with some movement downwards and outwards, may be observed, from the action of the superior oblique. The false image stands higher or lower than the true image, according as the sound eye is directed upwards or downwards respectively. Its upper end is inclined somewhat away from the sound eye, through the superior oblique having lost its antagonist. Incomplete forms of third-nerve paralysis are frequently met with. Occasionally, one or other of the muscles is affected alone. Isolated paralysis of the inferior oblique is very rare, but well-marked cases have been observed; the symptoms are the counterpart of those of paralysis of the superior oblique.

SIXTH-NERVE PARALYSIS.—Loss of movement outwards beyond the middle line; deviation of the eye inwards, through unopposed action of the internal rectus—i.e. convergent strabismus, increased by efforts

to look towards the paralysed side, decreased by looking in the opposite direction. Homonymous diplopia—i.e. image of right eye standing to the right, image of left eye to the left, or the diplopia is avoided by a compensatory turning of the head towards the paralysed side, or by keeping one eye closed or covered. When the eyes are directed horizontally, the false image is erect, and on the same level as the true image; but, in looking upwards, it stands a little lower than the true image, and in looking downwards it stands higher. These changes are probably due to the actions of the oblique muscles being somewhat modified, as compared with those of the fellow eye, by the deviation inwards.

FOURTH-NERVE PARALYSIS.—Defect of mobility hardly to be discovered, even on close inspection; but the diagnosis made easily from the diplopia. Double vision occurs only on looking below the horizontal line, for only in this direction does the muscle normally come into action. The false image is lower than the true, and inclined towards it; the images are homonymous, each opposite to its own eye. The displacement of the false image increases as the eyes are directed more downwards and towards the affected side. Near to the horizontal line the false image overlaps the true; above the horizontal line vision is undisturbed.

Two or more of the foregoing forms of paralysis may occur together, from lesions involving several nerve-trunks, and they may occur bilaterally from lesions which damage the nerve-trunks of both sides. Bilateral affections, however, are in many cases due to disturbance in a centre common to fibres passing to both sides. The latter diagnosis is indicated when the movements of the eyes are found to be concomitant—i.e. when the two eyes move with equal excursions. An exception to this rule presents itself sometimes in the late stage of a peripheral paralysis, when, though the actual paralysis has entirely disappeared, the eye still deviates through shortening of the antagonist muscle; under these circumstances, since the conductivity of the nerves is equal on the two sides, the movements are strictly concomitant.

Treatment.—In presence of certain of the causes enumerated above, treatment directed especially to the ocular paralysis would obviously be out of place. Uncomplicated paralysees of single nerve-trunks, such as occur from chill, usually tend to spontaneous recovery. Iodide of potassium in moderate doses should, however, be given

In all such cases, whether syphilis be definitely concerned in them or not. Mercury may sometimes be desirable as well. With a view to preventing recurrence, the habits of life and constitutional state, especially with regard to lithiasis, should be attended to. The temple of the affected side should be protected from cold by a silk handkerchief tied round the head. In the early stages, a shade should be placed over the affected eye to remove the diplopia; later, when movement is returning, the weak muscle should be exercised each day by attempts at the movement in question, while the good eye is covered. The recovery of single vision may sometimes be promoted by the use of a prism, which partly corrects the deviation. Electricity effects an immediate and marked improvement in some cases, and, though the immediate result is usually transient, a systematic repetition of the remedy may aid recovery. Galvanism (primary continuous current) is probably more useful than faradism (induced current), because its action is more penetrating, but the latter also gives positive results. Armed with moist sponges, the anode is applied to the neck in the neighbourhood of the mastoid process, the cathode over the closed eyelids. The sitting should not last more than two or three minutes, and should be repeated daily or on alternate days. The strength of the current must be such as not to cause pain, and being especially necessary in the case of the continuous current. Operative treatment is only justifiable when all improvement has been at a standstill for some months; then, if the paralysed muscle have recovered some power, but deviation persists in consequence of shortening of the antagonist, tenotomy of the latter, and sometimes advancement of the former, may be performed with advantage. These operations are described in connection with STRABISMUS.

CONCOMITANT AFFECTIONS.—This group includes the common convergent strabismus of hypermetropia, the divergent strabismus of myopia, conjugate deviations, ophthalmoplegia externa, nystagmus, and some other varieties of motor disturbance depending on excessive or defective action of the brain-centres. The common characteristic is that there is a similar fault of movement in both eyes, the disturbing cause having effect either in the centres which govern bilateral movements, or at any rate so high up in the nerve-mechanism as to involve fibres belonging to both sides. It will be convenient to speak here of the

paralytic conditions, as they are allied with the diseases described in the foregoing paragraph. See STRABISMUS.

Conjugate Paralysis.—Both eyes deviate to one side and cannot be turned towards the opposite side. The causes of this affection are the same as those of other central paralyses. It is generally but not always associated with hemiplegia. If the eyes are turned to the right, the lesion is situated in the right side of the brain and involves the centre which normally turns both eyes towards the left. The deviation is due to the unopposed tonic contraction of the corresponding centre in the left side. Conjugate deviation to the right, therefore, goes with left hemiplegia; the patient cannot look to his paralysed side. It is the motor analogue of the sensory symptom, hemiopia, in which a lesion of the right side of the brain blinds the right half of each retina, and the patient cannot see to his paralysed side (Hughlings Jackson). The right halves of the two retinæ in conjunction constitute the visual organ for the left side; hence a lesion on the right side of the brain, whether it cause hemiplegia, conjugate deviation of the eyes, or hemiopia, tells in its results always in the same direction. Although the two recti which are concerned in this paralysis are totally inactive for conjugate movements, they may remain active for convergent and divergent movements; thus, in a case observed by the writer (*R. L. Ophth. Hosp. Reports*, vol. viii. p. 185), neither eye could to the smallest extent follow the movement of an object moved laterally before the patient's face, but both eyes performed movements of convergence when the object was moved from a farther to a nearer point, in line with the oblique direction of the eyes. Conjugate paralysis may rapidly disappear, or it may be of long duration. In several cases observed by the writer, the recovery of movement has been unsymmetrical on the two sides, the eye turned outwards returning to its normal position sooner than the eye turned inwards, so that a convergent squint resulted.

Paralysis of Convergence.—The power of converging the eyes is lost, and there is a fixed divergence, which the strongest effort on the part of the patient is unable to diminish. The fixity of the divergence distinguishes the disorder from ordinary divergent strabismus, such as occurs in myopia and after an excessive tenotomy, for, in the latter, the divergence diminishes during efforts of accommodation for a near object. Yet there is no true paralysis of the internal

recti, for conjugate movements to either side are performed with ease. This eliminates the possibility of lesion of nerve-trunks, and indicates a lesion in the centre for convergence or of strands connected therewith.

Paralysis of Divergence.—This is a counterpart of the foregoing. The eyes maintain a fixed convergence, which does not diminish on looking at a distant object, and which is thereby distinguished from the ordinary convergent strabismus of hypermetropia; yet the external recti are not paralysed, for conjugate movements to either side are performed freely. These conditions are rare. In a case of each form observed by the writer (*op. cit.* vol. ix. pp. 22, 428), the paralysis involved not only the movements of convergence and divergence respectively, but also those movements which, as before stated, appear to be anatomically associated with these. In the one case, there was total loss of convergence, downward movement, accommodation, and contraction of the pupils in both eyes; in the other, there was total loss of divergence and upward movement in both.

Ophthalmoplegia externa is a term used to indicate loss, partial or complete, of all movements in both eyes. It implies a central lesion of a more extensive kind than those which cause the paralyzes of particular movements above described. It represents the simultaneous occurrence of all these forms. Accommodation and contractility of the pupils may, however, remain intact.

Nystagmus. See NYSTAGMUS.

Spasm.—It is probable that each form of bilateral deviation, described above, may occur from spasmodic action as well as from paralyzing lesion. Over-action of the convergent centre, associated with accommodative spasm, occurs in some cases of hysterical paroxysm. It is the cause also of some cases of concomitant strabismus, in young children who are not hypermetropic. The commonest form of deviation from over-action of this centre is that which results from hypermetropia. See STRABISMUS.

PRIESTLEY SMITH.

ODONTOMA, or TOOTH TUMOUR, is the name originally given by Broca to the group of cases in which the tumour consists of tooth-elements more or less hypertrophied. The majority of these are outgrowths from the pulp of well-formed teeth, or at least have their connection with the teeth well marked, and are, therefore, of interest, principally, to those engaged in dental surgery.

There is one form of odontoma, however, which is strictly surgical, since it is apt to give rise to serious mistakes in the diagnosis and treatment of one form of tumour of the jaw. This depends upon some modification of the germs of one or more of the molar teeth of the lower jaw, before the development of the cap of dentine, which leads to the formation of an irregular mass of dental tissues, in no way resembling a tooth in shape. These cases are very rare, and occur only in the lower jaw. The symptoms are those of a dense tumour expanding the bone, in which there is no pain, unless the mass should interfere with the development of the wisdom-tooth, or be mistaken for a misplaced tooth or a sequestrum, when acute inflammation may be excited in the jaw itself by ineffectual attempts at removal. Very eminent surgeons have been misled by these cases, and have unnecessarily sacrificed portions of the lower jaw, when, as experience has shown, enucleation of the growth could invariably have been undertaken with success. The writer recently had a case of the kind under his care, in which persistent efforts to remove what was supposed to be an impacted tooth had given rise to so much inflammation about the jaw and gums that, when the writer was first consulted, he believed the patient to be suffering from a rapidly growing tumour of the interior of the jaw, and recommended removal of a portion of the bone. Fortunately, on the subsidence of the inflammation, the case more resembled one of necrosis, and on attempting to search for and remove a sequestrum, an odontoma measuring $1\frac{1}{4}$ by $1\frac{1}{2}$ inch, and weighing 315 grains, was readily enucleated. This consisted of dental tissues irregularly arranged, and represented one or two molar teeth.

Displacement of otherwise healthy and well-formed teeth may give rise to enlargement of either jaw, and even supernumerary teeth have been known to form distinct tumours connected with the maxillary bones. Such cases must necessarily be very difficult of diagnosis, and are best treated by exploration before any serious mutilation is undertaken.

CHRISTOPHER HEATH.

CEDEMA is the result of undue exudation of serum or liquor sanguinis into the interstices of connective-tissue and lymphatic vessels. There are several possible factors, one or more of which may be involved in a given case. Foremost, on account of its frequency and extent, is

increased pressure in the capillaries. This, in turn, may be the consequence simply of venous obstruction, as when a vein is ligatured, varicosed, occluded by a clot, or pressed upon by a tumour or aneurism. Or, the feeding arteries may be flooded from paralysis of the vaso-motor nerves, a condition occasionally seen when the lower extremities are œdematous in fracture of the spine, even in the absence of renal or heart disease, or any extrinsic cause of obstruction to the flow of blood. Another illustration of this variety of œdema is afforded by the rapid but transient swelling which follows sharp irritation of the skin. Cardiac feebleness, again, may be so marked that the inertia of the column of blood in the veins is with difficulty overcome. The back-pressure on the capillaries, even if it does not lead to stagnation therein, is sufficient to account for very considerable exudation of serum. Familiar examples of this are afforded by the œdema of the legs in persons convalescent from the acute fevers, or weakened by some constitutional malady like cancer, or reduced by protracted pyrexia, as in phthisis. 'Œdematous erysipelas' of old people, the subjects of feeble circulation, is another instance in point, and, inasmuch as one cause of the œdema is abiding, there is permanent enlargement of the part, which becomes more solid with the lapse of time.

Now, since the pressure in the *lymphatics* reciprocates that in the blood-vascular capillaries, it will easily be seen that blocking of the former may, of itself, entail obvious transudation of fluid into the areolar spaces. *Elephantiasis*, as met with in Orientals, is largely due to distension of the lymphatics, which are infested with the parasite *filaria sanguinis hominis*. Again, there are grounds for the belief that coagulation of lymph in its accustomed channels forms part of the pathology of *phlegmasia alba dolens*. On the other hand, when the hindrance to the venous circulation is great, the surrounding lymphatics are dilated. Amussat found this a frequent occurrence in varices.

Nor must the state of nutrition of the blood-vessels be ignored. The capillaries are subject, with the other tissues, to fatty atrophy from disease, whether it be from palsy of the limbs or from forced rest, as in fractures. Sustained high temperature causes a similar change, and this is another explanation of the œdema met with after the specific fevers and other acute febrile disorders. In albuminoid disease, the alteration in structure of the coats of the

small arteries facilitates the transudation of serum.

The composition of the blood must have some influence on the exosmosis, for it is well known that the rate of dialysis varies directly with the amount of crystalloid elements contained in a given fluid.

In certain cases, œdema appears to be to some extent compensatory to the removal of the normal constituents of the tissues; thus, it is not rare to find adipose tissue infiltrated with serum coincidentally with the absorption of fat from the cells, in wasting diseases like phthisis.

It should be borne in mind that a general tendency to dropsy causes the swelling associated with a local inflammation to appear out of all proportion to the intensity of the irritation—e.g. extensive œdema at the site of an eczematous patch at once raises the presumption of albuminuria, which may not have been previously suspected either by the surgeon or patient.

VARIETIES OF ŒDEMA.—It is customary to divide ordinary cases of œdema into two groups—(1) *simple or serous*, and (2) *inflammatory or plastic*. The former occurs in renal and cardiac disease, and in many forms of local obstruction to the circulation. Simple serum differs from inflammatory fluids in that it contains no fibrinogen, for it does not coagulate spontaneously on exposure, nor on the addition of red blood-corpuscles. It is highly albuminous. Tissues infiltrated with serum pit deeply on pressure. They are paler than natural, and look glistening and jelly-like. On section or puncture the fluid rapidly escapes, being expressed by the elasticity of the connective-tissue fibres between which it is contained.

Inflammatory œdema, or the 'hydrops fibrinosus' of Vogel, varies within very wide limits both as to its extent and solidity. The looser the texture of the tissue infiltrated the more marked is the swelling. It is quite phenomenal in the scrotum, where it occurs from local causes—wounds, extravasation of urine, &c.—and as a sequel of scarlet fever and smallpox (Erichsen).

Acute œdematous laryngitis, especially when it follows perichondritis, is of grave clinical significance, owing to the rapidity of the exudation and the encroachment of the swelling on a vital part of the economy. Chemosis of the conjunctiva is another example of sudden development of œdema.

The fluid may be so highly fibrinous as to coagulate quickly and firmly. This is one form of 'solid œdema.' On the contrary, it may remain in the liquid state two

or three days in a limb that has been amputated for cellulitis.

Renal and cardiac disease diminish the tendency to coagulation by lessening the amount of fibrinogenetic substances in the fluid, which is then in fact a mixture of serous and plastic effusion. This combination is not uncommonly met with in the lungs of patients who have succumbed to renal disease. The lung-texture is lacerable from the pneumonic change, and loaded with serosity from the 'serous apoplexy.' It may here be noted that simple serous effusion, within the ventricles of the brain and beneath the arachnoid membrane, presents a somewhat cloudy appearance, which is commonly mistaken for evidence of meningitis. On dissection, however, it is found that the pia mater can be readily stripped from the cerebral substance, and the convolutions separated without tearing.

Œdema, both simple and inflammatory, is seen in connection with fractures of the bones, where it is due partly to the rupture of vessels and the pressure of blood-clot, and partly to exudation the result of injury to the tissues. It may be considerably increased by the injudicious application of bandages and splints, when the tension on the capillaries may become so great as to lead to sloughing of the soft tissues.

Malignant anthrax œdema.—In some cases of anthrax or charbon, where the typical 'pustule' is absent, there is firm gelatinous œdema, especially about the eyelids; and in another manifestation of the disease, called *internal anthrax*, there is commonly brawny œdema of the cellular tissue of the neck.

Myxœdema.—The chief anatomical change in this affection is a conversion of the gelatin and chondrin of the connective-tissue—particularly of the hands, feet, and face—into mucin, a reversion as it were to the embryonic condition. The skin looks swollen and has a waxen appearance. There is little or no pitting on pressure unless the kidneys are diseased, when ordinary serous œdema may be added to the more special features of the case.

Duration of Œdema.—Œdema may be so transient as to last only a few minutes, as when a wheal is produced by flagellation. Or it may be long abiding from (a) continuation of the cause—e.g. varicosity of the veins of the leg and cachectic states of the body; (b) permanent occlusion of blood-vessels and lymphatics—this is sometimes seen in 'white leg'; (c) coagulation and subsequent organisation of the inflammatory effusion.

The *density* of the swelling varies as the amount and coagulability of the fluid effused and the time it remains unabsorbed. The higher grades are designated '*solid œdema*,' for there is little pitting on pressure, and change of position has very slight effect upon it.

Treatment.—The chief indication is to remove all causes that impede the circulation. In the varicose œdema of the legs, pressure by means of an elastic bandage evenly and continuously applied is the method to be adopted.

In most cases, considerable aid may be obtained by elevating the limb sufficiently to allow of the ready return of blood from the veins, without materially increasing the resistance in the arteries. This plan is especially applicable to fractures of the leg, where pressure cannot be safely employed.

In long-standing cases—e.g. those due to wide-spread thrombosis of the veins—massage, with after-pressure, will help in the absorption of the exudation. This plan is excellent if systematically carried out.

In acute inflammatory œdema, where there is danger of sloughing, free incisions should be made; and where this is not practicable, as in the throat, the part should be scarified.

Serous œdema from renal or cardiac disease, which cannot be overcome by posture and the administration of drugs, may be relieved by a number of fine punctures made in the skin with a darning-needle, or Southey's tubes may be inserted.

AUGUSTUS J. PEPPER.

ŒSOPHAGOTOMY is required for the removal of foreign bodies impacted in the upper part of the œsophagus, when all other methods of extraction have failed. It has been also performed to facilitate internal division of a stricture of the œsophagus.

The patient should be placed upon his back with the head and shoulders slightly raised, and an anæsthetic should be given. The face should be turned to the side opposite to that on which the incision is made. This should be the left side, unless there is a decided projection, caused by the foreign body, to be felt upon the right side.

An incision, three to four inches long, should now be made through the integuments along the anterior border of the left sterno-mastoid, with its centre corresponding to the position of the foreign body. The skin, superficial fascia, platysma myoides, and deep fascia will be thus divided; the sterno-mastoid will be exposed, and it should be drawn outwards by a retractor.

The carotid sheath now comes into view, with the descendens noni nerve lying upon it, and the omo-hyoid muscle crossing it. The sheath should be carefully separated by a blunt director or the finger from the trachea, the thyroid body, and the larynx, with the depressors of the hyoid bone which cover them. The omo-hyoid muscle should be drawn outwards, or, if it is found to be in the way, it may be divided. Care should be taken to avoid wounding the superior and inferior thyroid arteries, and the recurrent laryngeal nerve, which lies in the groove between the trachea and the œsophagus. The superior and middle thyroid veins may have to be ligatured and divided.

When the carotid sheath and its contents, together with the sterno-mastoid and the omo-hyoid, have been drawn outwards by a large blunt retractor, and the trachea with the overlying structures has been drawn to the opposite side in a similar manner, the œsophagus and lower part of the pharynx will come into view. If the impaction be low down, it may be also necessary to divide a few of the outer fibres of the sterno-hyoid and sterno-thyroid muscles. A long-handled curved forceps should now be introduced through the mouth, and when it has reached the foreign body the blades should be expanded, so as to indicate clearly the part of the œsophagus which has to be incised. A longitudinal incision should now be made in the œsophageal walls, of a size determined by that of the foreign body. If it should be found to be too small, it may afterwards be enlarged upwards or downwards, as may be most convenient. All vessels that bleed should at once be tied, firstly, in order that the parts may not be obscured by blood, and secondly, to prevent the cellulitis which might follow the decomposition of blood extravasated through the tissues. As soon as the opening has been made, the finger should be introduced and the exact position of the foreign body ascertained. It may then be laid hold of by appropriate forceps and cautiously removed.

If the impaction is quite recent, and the œsophagus free from inflammation or laceration, it may be safe to carefully bring together the edges of the œsophageal wound with chromicised catgut sutures, while the edges of the external wound are left open for the discharge of blood and serum, and of any foreign material which may escape through the walls of the œsophagus. In many cases, however, it is advisable to leave the wound of the walls of the canal open, as well as that of the superficial

structures. For a week or more after the operation the patient must be fed with a small œsophagus tube, which may be left in, or if the patient cannot bear this, it may be passed for every meal. Nutrient enemata may also be necessary for a few days. Later on, the patient should be allowed to begin cautiously the swallowing of liquid food. There will often be a small fistulous opening for a few weeks, but this usually closes without any trouble.

ŒSOPHAGOSTOMY is performed in the same manner as the operation just described, except that the incision should be as low on the left side of the neck as practicable. The œsophagus will have to be found without the guidance of the forceps or sound introduced by the mouth, and after it has been found and opened, the edges of the incision, and especially the margins of the mucous membrane, should be carefully stitched to the skin at the lower extremity of the external wound. In the after-treatment, great caution must be exercised in introducing the feeding tube, to avoid laceration of the wall of the œsophagus, or the passage of the instrument by its side into the adjacent tissues.

N. DAVIES-COLLEY.

ŒSOPHAGUS, Injuries and Diseases of the.—FOREIGN BODIES of various descriptions are apt to become impacted in the œsophagus, such as masses of imperfectly chewed food, bones, and especially fish-bones; pins, coins, and other metallic substances; and lastly, artificial teeth, which, with the plates to which they are attached, have, of late years, frequently been swallowed, and after lodging in some part of the canal, have become firmly fixed by the hooked projections or 'bands' with which they are provided. The point of impaction is usually one of the three natural constrictions of the œsophagus, and especially the highest, which is at the upper extremity, just below the level of the cricoid cartilage; the second constriction is three inches lower, where the œsophagus deviates slightly to the right, to pass under the arch of the aorta; and the third is where its lower extremity traverses the diaphragm.

The *symptoms* will vary in some degree with the position of impaction. If this is high up, there may be considerable dyspnœa and coughing from laryngeal irritation. Pain may be complained of at the spot where the body is fixed, or it may be referred to some other region, such as the notch of the sternum. If the body is in the cervical portion of the canal, there will

probably be some tenderness upon external pressure. Swallowing is usually difficult and painful, and it may be impossible; or, after the food has been swallowed, it may be retched up again. When the obstruction is complete, there will be a constant expectoration of saliva and mucus. In some instances, foreign bodies have remained for a long time without giving rise to any serious symptom. Usually, however, ulceration supervenes, and its presence will be indicated by the blood and pus retched up by the patient. Abscesses may follow in the adjacent tissues, the air-passages may be opened, and inflammation set up in the lungs; or some great vessel, such as the aorta, may be perforated, and give rise to sudden and fatal hemorrhage. In rare instances, it has happened that the ulceration has loosened the impaction, and permitted the foreign body to be ejected through the fauces, or to pass onwards into the stomach.

The *diagnosis* is sometimes rendered difficult by the fact that, after a foreign body has been dislodged, some abrasions may have been left, and the uneasy sensation still remaining may convey the impression that no change has taken place in its position. If the body is large, and not entirely in the œsophagus, it may be possible to reach its upper extremity by means of a finger inserted through the fauces, or its exact situation may be detected by some projection to be felt externally. When it is high up in the gullet the laryngoscope will also be of service, but in many cases it will be necessary to rely upon the passage of a probang furnished with a smooth metallic or ivory bulb, by which contact with any hard substance will be communicated to the fingers. If there is any suspicion that a previously impacted body has been dislodged, a careful examination should be made of all vomited and fecal matters.

Treatment.—Foreign bodies in the œsophagus must be removed by the mouth, or pushed onwards into the stomach, or in rare cases it may be necessary to cut down upon them in the cervical portion of the canal. If the body be high up, a sudden jar, such as a slap on the back, may dislodge it into the pharynx, whence it will probably be ejected by the spontaneous efforts of the patient. The vomiting which occurs during the examination of the parts is also sometimes effectual in displacing the foreign body, and emetics have been given by the mouth, or where this was impossible, by the rectum or subcutaneously, with the same object. Such an expedient,

however, would only be justifiable if the body were small and recently impacted, for there is some danger of rupture of the œsophagus during the efforts of vomiting. If the body is a mass of solid food, or if, though hard, it is smooth and not very large, it may be gently pushed on by means of a sponge probang into the stomach. The same plan may also be resorted to when a sharp or angular body has become impacted low down, and has resisted repeated efforts to extract it. Should such a body have entered the stomach, it will be necessary to keep the patient quiet, and to give him plenty of solid bulky food with but little fluid, so as to secure the safe transit of the foreign body through the intestines.

When, however, the impacted foreign body is hard, angular, and of considerable size, and especially when it is fixed high up, we should endeavour to remove it with the long-handled curved forceps. Coins may be extracted by means of a special apparatus, consisting of a blunt flat hook attached by a thin slip of steel to the probang. They are usually impacted high up, with their flat surfaces directed forwards and backwards. For pins, fish-bones, and similar substances, the dilating horsehair-probang is of great value. This should be introduced into the gullet for a short distance beyond the obstruction, and then, after expansion, be gently withdrawn. If this instrument be not at hand, a good substitute may be made by attaching a skein of thread to the end of a flexible bougie, so as to entangle the body in the numerous loops which are thus formed. Fish-hooks have been removed by means of a perforated bullet or ivory ball threaded on the gut, and then pushed down so as to fill the concavity between the barbed point and the shank.

If, however, all these methods have failed, and if the foreign body remains in or near the cervical portion of the œsophagus, operative interference should at once be resorted to, without waiting for the complications which the ulceration of the walls of the canal will soon produce. See *ŒSOPHAGOTOMY*. In some cases, in which dyspnoea is an urgent symptom, it may be necessary to perform laryngotomy before attempting to extract the foreign body. After it has been removed, the patient should be kept quiet, and fed with milk and other unirritating liquids.

INJURIES of the œsophagus most frequently occur from the accidental or suicidal swallowing of strong acids or caustic alkalies. The patient is usually much col-

lapsed, and there may be lividity and severe dyspnœa from laryngeal spasm. The tongue, fauces, and pharynx are white and wrinkled, or red and swollen, according to the nature of the material swallowed. There is intense burning pain in the throat and along the gullet. Vomiting may occur, and the ejected matter will consist of altered blood and shreds of mucous membrane, mingled with the contents of the stomach. At a later period there will be frequent retching up of thin, watery, blood-stained mucus. If the stomach was empty when the material was swallowed, the inflammation and perforation of its walls will usually prove speedily fatal. If, however, the œsophagus has received the chief injury, sloughs will come away and a stricture will gradually form, which may lead to the slow starvation of the patient.

Treatment.—When the patient is able to swallow, the appropriate antidotes should be at once administered to neutralise the action of the poison. *See* ACIDS, ALKALIES, Swallowing of. The patient must be kept quiet, and fed with nutrient enemata, to which small quantities of tincture of opium may be added. When the acute inflammatory symptoms have begun to subside, liquid nourishment may be given by the mouth, and bougies should be passed to prevent contraction, or in some cases a soft tube may be retained in the canal, and the patient fed through it. The surgeon should also be prepared to perform laryngotomy, if the dyspnœa from œdema glottidis or spasm should threaten suffocation.

Serious and even fatal results have occasionally followed other forms of injury. The performers of so-called sword-swallowing have sometimes died suddenly from the perforation of a great blood-vessel or of one of the serous cavities of the thorax; or acute and sometimes fatal inflammation of the coats of the œsophagus has resulted from its repeated irritation. In violent efforts of vomiting, the gullet has been lacerated or completely torn through. It has also been wounded from without by stabs or incised wounds of the neck (*see* THROAT, Injuries of the), and more rarely in those of the thorax. In all these cases, rest with a milk diet will be necessary, and in the more severe cases, especially when there is perforation of the coats, the patient must be restricted to nutrient enemata.

DISEASES.—With the exception of stricture, the diseases to which the œsophagus is liable are rare and comparatively trivial. It is sometimes the seat of a transient

catarrhal inflammation, of which the chief symptoms are pain and difficulty in swallowing. Diphtheritic exudation, aphthous ulceration, and submucous abscesses are occasionally observed. In tertiary syphilis we may get gummatous deposits and ulceration, which are very likely to lead to a subsequent stricture. After death, not infrequently warty growths are found in the mucous membrane, or cysts in the submucous tissue, or myomata in the muscular coats; but these very rarely cause any serious inconvenience during life. In rare instances, congenital malformations have been recorded, such as an imperforate condition, which is of course rapidly fatal; or a diverticulum, forming a pouch in which food may collect. This has usually been in the cervical region, and it has sometimes been indicated during life by the formation of a visible swelling after a meal, which could be emptied by external pressure. Similar pouches are also said to occur lower down, as the result of the perforation of the tube from abscess of a bronchial gland.

STRICTURES of the œsophagus may be classed under three heads—(1) Spasmodic, (2) simple, and (3) malignant. Dysphagia may also be occasionally due to causes external to the gullet. An enlarged gland or tumour, or an aneurism, may sometimes compress the canal, and so produce the symptoms of stricture. As a rule, however, a bougie can be passed into the stomach in these cases, and if the obstruction be situated in the neck, its character can be ascertained by external examination; if in the thorax, an exact diagnosis will be difficult, except sometimes in the case of aneurism, which may be recognised by auscultation or a comparison of the radial pulses. *See* DYSPHAGIA.

1. *Spasmodic stricture* is usually, but not invariably, met with in hysterical women, and it may be associated with a slight amount of genuine contraction.

2. *Simple stricture* is, almost always, the result of cicatrization after the destruction of the coats of the œsophagus by some escharotic agent. Occasionally, however, it is set up by some other form of ulceration, such as that which follows syphilitic deposit or the temporary impaction of a foreign body. In a few instances, a contraction of some part of the œsophagus, and especially of its cardiac end, appears to have been congenital, or to have occurred, without any obvious cause, in very early life. This may consist of a mere fold of the mucous membrane, or it may affect all the structures of its walls.

3. *Malignant stricture* is by far the most common form, and it is nearly always epitheliomatous. Beginning in the mucous membrane, the disease spreads to the subjacent coats and sometimes to the neighbouring glands. Colloid, scirrhus, and other forms of tumour have been recorded. The disease may be annular, or it may be confined to one side of the tube.

The chief *symptom* of stricture will be dysphagia. This is at first slight, the patient having to cut up or bite his food smaller, and being a little slow in swallowing it down. Soon there is complete inability to eat solid food, which is either ejected by retching, or else a piece becomes fixed in the tube for some time, and prevents the passage even of liquids, until it is dislodged from its position. In some instances, such a stoppage comes on suddenly and is the first indication of the disease. The patient has now to subsist entirely on fluids, and he gradually emaciates. There is frequent vomiting or retching of frothy mucous fluid, in great measure derived from the unswallowed saliva, and if there is ulceration, this will be accompanied by small quantities of stinking pus and blood. There may be pain in the gullet, or it may be referred to some other part, such as the notch of the sternum. At first the sense of hunger is great, but often, in the later stages, the patient becomes apathetic and loses this craving. Finally, the disease is usually fatal by starvation; but, in the malignant form especially, death often occurs from some perforation of the air passages, which allows food to pass into the lungs and set up pneumonia, or some great vessel may be opened by ulceration, and prove fatal by profuse hæmorrhage.

The *spasmodic* form may be suspected in neurotic patients, where there is but little emaciation or loss of strength. The inability to swallow is apt to be inconstant, and there is not the intense craving for food which is characteristic of genuine stricture. Usually, a full-sized bougie can be passed with or without the aid of an anæsthetic.

When, however, there is a distinct history of continuous dysphagia, accompanied by progressive emaciation and a constant desire for food, the diagnosis will lie between *simple* and *malignant* stricture, and will depend chiefly upon the history of the case, the age and sex, and to some extent also upon the general appearance of the patient. If the obstruction is high up, an external examination may reveal some swelling or induration of the

neck, from cancer of the œsophagus or its lymphatic glands. In most cases of malignant stricture the disease begins without any assignable cause. The patient is generally of the male sex, and over forty years of age. There may be some appearance indicating a special cachexia, but this will be difficult to distinguish from the emaciated condition dependent upon the privation of food. In the simple form there will be the history of some cause, such as the swallowing of a corrosive substance, or the impaction of a foreign body; or the patient may have been the subject of syphilis, of which traces may be looked for upon the skin, the tongue, and the fauces. In the rare cases in which the contraction has existed from birth or early childhood, there will probably be a history of slowness in swallowing, and of regurgitation, or, so to speak, rumination of the material swallowed.

In all cases of stricture, the diagnosis is much helped by the use of a flexible bougie about three-eighths of an inch in diameter. The mouth of the patient should be widely opened, and the head thrown back. The instrument, after being well softened in warm water and oiled, should be passed with the operator's right hand, his left index finger guiding it into the pharynx and past the orifice of the glottis. Frequently, a slight hitch is felt when the bougie has reached the notch of the sternum or a little lower. This may be due to the change of direction of the œsophagus at this point, corresponding to the change from the anterior convexity of the cervical spine to the concavity of the dorsal region. If the œsophagus be healthy it is only necessary to make the patient bend the head forwards, and the instrument will slip on till it reaches the stomach, and is stopped by coming into contact with the greater curvature of that organ. If more than sixteen inches of the bougie are found to have passed the front teeth, we may be certain that the whole of the gullet has been traversed. If, on the other hand, the instrument be stopped before this length has passed, and if after slight withdrawal or rotation, or after flexion of the neck as above described, the instrument fails to penetrate further, there is probably a stricture at the point reached, and the position of the stricture is indicated by the length of the bougie which has been inserted. The exact point in the œsophagus is easily ascertained by subtracting six inches from the amount, that being the average distance of the upper

end of the canal from the front teeth of the adult.

On withdrawing the instrument, it should be carefully examined for indications of ulceration, which it may afford by a smear of blood or pus upon its surface. In many cases it will be necessary to use bougies of other sizes and shapes, and in some it may be desirable to have the assistance of an anæsthetic, to overcome the spasm which resists the introduction of the instrument. Some information as to the position and narrowness of the stricture may be also obtained by auscultation with a stethoscope placed on the left side of the trachea in the neck, or to the left side of the spines of the vertebræ in the back.

Treatment.—In the *spasmodic* form, nervine tonics and sedatives should be given, and a bougie should be passed from time to time; the local application of galvanism is also beneficial.

In the *simple* form, early recourse should be had to dilatation by bougies, even before the granulating sores which precede the contraction have completely healed. The instrument, when passed, should be left in for a few minutes daily, and cautious attempts should be made to introduce larger sizes, until the full calibre of the canal has been restored. In some cases it is possible to introduce only a fine catgut bougie. If so, this may be used as the guide for passing gum elastic tubes of various sizes, which may be left for several days in the œsophagus, the patient meanwhile being fed through the tube. Great care is necessary in the introduction of bougies, for there is often a pouched condition of the gullet above the contraction, which renders the upper orifice of the stricture difficult to find. At the same time the walls of the pouch are thin and soft, and they have sometimes been perforated with fatal results. Until the œsophagus has been dilated, the patient should be fed with fluid diet, for otherwise great distress may be produced by temporary closure of the stricture with a morsel of solid food.

Internal Œsophagotomy has been occasionally performed as a help to dilatation, but there is danger of cutting beyond the walls of the canal, and opening some large vessel or one of the adjacent serous cavities; while the cases, in which alone it can be practised, are of permeable strictures, and may be more safely treated by bougies.

If, after repeated efforts, it is found impossible to pass a bougie, even with the help of an anæsthetic, and if the ability to

swallow even liquids is gradually diminishing, while the patient steadily loses weight and strength, it will be necessary to resort to *GASTROSTOMY*, which has, as might be expected, yielded much better results in this than in the malignant form of stricture. It is important to perform this operation while the patient has still strength enough to bear the diminution of food necessitated during the establishment of the artificial opening, as well as to permit of the formation of firm adhesions between the stomach and the parietes. When formed, the gastric opening will usually require to be permanent, but, in some instances, the rest thus given to the stricture has led to its amelioration; the power of swallowing has returned, and it has been found possible to close the opening.

Œsophagostomy has also been practised in a few cases. It is, however, only applicable where the stricture is limited to the upper part of the canal, and, even then, the dangers which attend it make the operation decidedly inferior to gastrostomy.

When the stricture is near the cardiac orifice, Signor Loreta has recently suggested and successfully carried out another operation. Having opened the abdomen and drawn a part of the stomach out of the wound, he makes an incision into it, and through the opening introduces a dilator into the lower part of the œsophagus, and, after forcibly dilating it, withdraws the instrument, sewing up the wound of the stomach wall, and returning the stomach to the abdominal cavity.

In *malignant* stricture, the treatment can only be palliative, except in the rare instances in which the disease is confined to the upper part of the canal; in which case it may be possible to remove the growth, and attach the upper end of the canal to the edges of the lower part of the wound, so as to provide an opening for the reception of food. See *Œsophagostomy*, under *ŒSOPHAGOTOMY*.

After the diagnosis has been made, so long as the patient is able to take plenty of liquid nourishment, it is unwise to use instruments, for fear of perforation. As soon, however, as the passage of liquid food becomes difficult, and the patient begins to waste, a flexible tube should be passed by the mouth or nose through the œsophagus into the stomach, and there retained, so as to allow of the regular feeding of the patient. As a rule, the stomach tolerates the presence of the tube, but if any symptoms of gastric disturbance arise, the tube may be withdrawn a short distance, so as

to place its lower end in some part of the œsophagus below the stricture, but out of the cavity of the stomach. Mr. Charters Symonds has recently suggested an improvement upon this plan. A gum elastic tube, furnished with a funnel-shaped upper expansion, is passed through the stricture until its dilated extremity rests upon the top of the stricture. It is inserted on the end of a conical bougie, or by a special introducer. The tube keeps the stricture from closing, and its calibre is sufficient to allow a free passage to properly prepared food, which can now be swallowed by the patient in the ordinary way. The saliva also and mucus, which, when the longer tube is kept in, well up into the mouth and have to be expectorated, are enabled by this method to pass onwards through the tube into the stomach. A piece of silk thread is attached to the upper rim of the tube, and brought out at the corner of the mouth, to be fixed by a loop round the ear. When it is desired to examine or change the tube, it is drawn up by means of the silk thread. After inspection it can readily be returned to its old position, or a larger one may be introduced in its place, as considerable dilatation results from the continuous pressure of the tube.

When, however, bougies cannot be passed, or if passed, cannot be retained, increasing weakness and wasting may render operative interference necessary. The most generally applicable is gastrostomy. In some cases in which the disease is situated high up, it has been proposed to establish an artificial opening in the lower part of the neck (see *Œsophagostomy*, under *ŒSOPHAGOTOMY*), but even in these cases the operation of gastrostomy is preferable.

N. DAVIES-COLLEY.

OLD AGE.—It would be useless to attempt to define in years the period of life which, in the study or the practice of surgery, shall be called old age. Its essential characteristics are the degenerations prevalent in all the structures and increasing in them. But these do not begin at nearly the same age in all persons or in all parts of the same person; and their advent and progress are so dependent on inheritance, previous health, occupation, and the other external conditions of life that, in practice, it is often better to estimate a patient's age by his appearance and physical capacity than by the years since his birth. It will be in this view that old age will now be spoken of in its relation to each of the chief subjects of general

surgical pathology, and first in its relation to injuries, including surgical operations.

The risks of shock, especially if it be prolonged and attended with enduring pain, increase with advancing age in the same measure as the accumulations of degenerative changes and the effects of previous diseases. The recovery from shock is often slow and interrupted by relapses, and sometimes old people who, in a calm life, have been deemed healthy, die very soon after the shock of injuries which to the younger might have been trivial.

Hæmorrhage is not especially dangerous to the aged, unless they be very infirm or unsound. This used to be often proved when free venesection was customary, and is shown in the facility of recovery from occasional large bleedings from the prostate, and from the epistaxis to which some gouty old persons are subject. Anæsthetics are generally well borne: but it is a good rule to use chloroform rather than ether, because of its lesser tendency to excite bronchial irritation or pulmonary congestion.

The repair of injuries, although with increasing age it becomes generally less ready and complete, is often very remarkable in even the oldest persons. This is especially true after injuries of the face and the upper half of the body; but in all parts and at any age healing may be expected unless hindered by local conditions, such as the impossibility of keeping parts in contact, as in fractures of the neck of the femur, or by conditions of general disease, such as would hinder healing at any age. Old persons appear, indeed, in less risk of the failure of local repair than of that general repair which should be achieved in convalescence. Some may have escaped all the immediate dangers of a severe injury or operation and all those of its earlier consequences, and the local injury may be nearly healed, but in what should be convalescence they waste, decay, and slowly die. This is especially likely to happen to those who are unable to take their usual food; and to those whose organs are not only degenerate through old age, but damaged by the effects of former diseases. Indeed, however striking may be the marked instances of repair of injuries in the aged, their risks from degenerate blood-vessels, weak hearts, habitual bronchitis, and other like defects, can never be deemed slight.

Among the sequences of injury, old persons are much less liable than the young to the infection of prevalent con-

tagions, such as scarlet fever and small-pox; less liable, also, to septic poisoning and pyæmia; rather more to erysipelas and to a more dangerous form of it with frequent relapses. Injuries, also, are very likely to bring out and localise the diseases to which old persons are liable; such as gout and osteo-arthritis, or the gangrene to which the diabetic are prone.

Inflammation in old age is usually less active than in earlier life; that is, under similar conditions and in the same parts, it is slower both in progress and in recovery; more likely to be or to become chronic; and, in cases which may be deemed of equal intensity, it is less productive of new organisable material, more prone to cedema, to mere congestion and gravitation of the blood, to more decay and sloughing of the softer tissues, or else to thickening and contraction which time does not repair. Commonly, too, inflammation in old persons shows less influence on adjacent lymph-glands than in the younger; they seldom become quickly or much swollen, still more seldom suppurate in a secondary inflammation. But the greater contrasts are due to the constitutional conditions which prevail in the different periods of life. Scrofula, which commonly gives its characters to the inflammatory process in early life, is in old age rare. Any scrofulous disease may, indeed, be found in even far advanced age, and all the characters of the scrofulous inflammation may be well marked in old persons who have never before shown signs of it; but this is as rare near the end of life as it is common near the beginning. The constitutions which more often put their mark on the inflammations in old age are the gouty and the so-called rheumatic gouty, such as appears in the changes of osteo-arthritis. These may be seen, indeed, in any period of life; but, even when they appear early or in middle age, they accumulate with advancing years, and are the cause of some of the most characteristic disabilities and infirmities of old age—the stiff curved spines, nodular and stiffened joints, contracted hands, deformed feet, and others. In all of these are evidences of thickened and contracted fibrous tissues, wasted articular cartilages, and nodular enlargements of the articular ends of bones, of which the type is seen in the justly named *malum coxæ senile*. And the effects of all these changes are the greater, because they coincide with the wasting and diminishing elasticity and

pliancy of tissues due to the natural senile degeneracies.

The progress of inflammation in old age is often affected by the accumulated changes of structure due to previous diseases in internal organs, especially those which hinder or weaken the movement of the blood, or materially alter its constitution. The persistency of eczema, and its tendency to ulceration in the lower limbs when the veins are varicose, is an example of the first, and the frequency of gangrene in senile diabetes is one of the second. There are also instances of peculiar nervous conditions in inflammation in old persons, such as the intense neuralgic pains which not only precede but often remain long after, the eruption in herpes zona, and in the pain of carbuncle and of senile gangrene, especially that which is associated with arterial degeneration.

In correspondence with the inactive and degenerative tendencies of inflammations in the old, they do not need, and often do not bear, active treatment. As a general rule, old people require more than ordinary care in securing rest and a good position for the inflamed part, warmth, sleep, a scarcely if at all diminished diet, comprising both vegetable and animal food, and, with moderation, any habitual quantity of stimulants. They commonly bear opiates well, especially when the inflammation tends to produce gangrene; but of other medicines it is generally true that, as age advances, so the utility of most things regarded as remedies in earlier life diminishes.

In comparing the pathology of Morbid Growths in old age and in earlier periods of life, it may be noticed that, although there may be no form of which the growth may not commence at any age, yet a very large majority of those commencing before the middle period of life are innocent tumours, and a very large majority after that time are malignant. In other words, the tumours which begin to grow in the earlier period are generally composed of structures like the fully organised and vascular tissues of the body; and those of the later period are generally composed of structures like the embryonic or the epithelial tissues. The contrast is marked enough to help in the diagnosis of tumours beginning in old age.

Among cysts, very few begin to form in old age. Sebaceous cysts sometimes do so on the scalp and on the trunk, but the more common event is, that they which have long existed, increase and ulcerate

through the thinned and feebly sustained skin. Seminal cysts, also, may first appear at an advanced age, and, even in the oldest men, they may be repeatedly filled with the characteristic fluid containing spermatozoa.

Fatty tumours, though rarely beginning, commonly continue to grow, in old age; and very often, with the progress of senile decay, the integument covering the most prominent or most dependent part of a fatty tumour sloughs or ulcerates, and may thus become dangerous to life. The chance of such an event may be counted among the reasons for removing such tumours in due time; for this chance is at least as great as that of the calcification of the tumour, in which its increase might be stayed. Many an old age is rendered unhappy by the weight and other troubles of a fatty tumour, which might have been removed safely many years before.

Among fibrous and myomatous tumours, those that are common in the prostate gland probably begin not rarely in old age, and those that have begun earlier may constantly increase. They are commonly a cause of the bossed and unsymmetrical shapes of enlarged prostate glands, and they are very rarely calcified. In this respect the uterine fibroid tumours differ from them; these not seldom in old age cease to grow, and become more dense and in parts calcareous. Of other fibrous tumours the growth may continue to the very end of life.

In cartilaginous tumours the decay of age is like to bring ossification; in osseous tumours increase. It is very rare to find instances of either kind beginning in old age, and in this there may seem strange contrast between the tumours and the very frequent and abundant osteophytes, which form, late in life, at the articular borders and other parts of bones.

Papillary tumours or overgrowths are commonly first formed in old age. They are exemplified in the warts on the scalps, and more rarely on the hands and feet of old people; in those of the tongue; and in the pigmental papillary growths on the back and other parts of the trunk; and in some of the 'bark-warts' on the face. Not a few of such papillary growths in the softer parts become in old age cancerous.

Nævi or erectile tumours, such as commonly begin in foetal life or earliest childhood, are in some degree imitated in old age, and in any time during or after middle life, by the little bright vascular spots which are commonly formed in the skin of

the trunk, especially in that of the front of the chest. But these never materially increase in size, or lead to grave disturbance, or need treatment.

The contrast between the whole group of the innocent and the malignant tumours, in respect to their first occurrence in the earlier or the later periods of life, has been already mentioned. A similar but not equal contrast may be observed between the two chief groups of the malignant, which are structurally distinguished as sarcomata and carcinomata, or as embryonic tissue and epithelial tissue tumours. The former may first appear at any time of life, and are more common in children and young persons than are many of the innocent tumours, such as the fatty and the fibrous. The latter are rare before middle age, but, after that time, their frequency in proportion to the number of persons surviving increases with advancing years.

Among the sarcomata, the myeloid, which, though structurally connected with the rest of the group, are clinically not malignant, are very rare in later life. So are the spindle-celled in an unmixed form; and these, also, are of the least malignant in that they very seldom recur at a distance from their primary seat, and very seldom infect the lymph-glands. Thus the less embryonic structures correspond with the less malignity.

The increasing frequency of cancer in advancing years is important in diagnosis. The older the patient the greater is the probability that a recently developed morbid growth is cancerous, or, at least, malignant. And it is true, not only of such as are produced in parts which previously appeared healthy, but of those which form in parts which were before harmlessly diseased. Thus, in advancing age, the crusted thickenings of skin called 'bark-warts' are apt to become seats of epithelial cancer; pigmental moles become malignantly melanotic. Similar changes not rarely occur in middle age; in the cancerous ulcerations of old scars, especially those of burns, and of the epithelial and papillary diseases of tongues; but, on the whole, the general rule seems true that the liability of many long-diseased parts to become cancerous increases with the increase of age. And another general rule, but subject to many exceptions, in the old is that the progress of cancers, both local and in their extension to lymphatics and distant parts, is slower than in the earlier times of life.

When cancer is transmitted by inheritance, it commonly appears earlier in those

to whom than in those by whom it is transmitted. The cancerous child may die before the cancerous parent; or a parent, who may have transmitted a tendency to cancer, may die before manifesting the disease in him- or herself.

The general characteristics of disease in old age are so especially illustrated in the diseases of some parts, that it is customary to class examples of them as distinct varieties. Thus, senile prurigo, senile purpura, and senile gangrene are often separately described, and may be studied as the best examples of disease modified by senile degeneration. They are treated of in their appropriate articles; and in several instances it is worth observing that the greatest frequencies of certain diseases are in old age and in early childhood. Thus it is with cataract, hydrocele, inguinal hernia, urinary calculus (at least among the children of the poor), phimosis, prolapse of the rectum, cutaneous warts, eczema, excess of uric acid, and some others. The causes of the similarly named disease at the two extremes of life may be in many respects widely different; the apparently similar result may be attained in dissimilar ways; but the fact may, nevertheless, deserve careful study.

JAMES PAGET.

OLECRANON, Fracture of the. *See* ULNA, Fracture of the.

OMENTAL HERNIA. *See* HERNIA, Reducible.

ONYCHAUXIS—Hypertrophy of Nail. *See* NAILS, Diseases of the.

ONYCHIA. *See* NAILS, Diseases of the.

ONYCHO-GRYPHOSIS — Horn, or Claw-like Nail. *See* NAILS, Diseases of the.

ONYCHO-MYCOSIS—Parasitic Disease of Nail. *See* NAILS, Diseases of the.

ONYX.—A crescent-shaped, purulent infiltration at the lower part of the cornea, resembling the *lunula* of a finger-nail. It may be mistaken for hypopyon, and is indeed often associated with it. Unlike the latter, it does not change position with movements of the head. *See* HYPOPYON.

OÖPHORECTOMY.—This term is generally applied to the operation for the removal of an ovary or ovaries which, though diseased, are not so diseased as to form tumours of any size. It is also applied to the operation for the removal of

healthy ovaries, the object being in this case to bring on the menopause prematurely, and thus, by arresting the monthly nervous and vascular excitement in the uterine organs, to cure other diseases which are thought to be dependent upon these periodic disturbances, or are exacerbated by them. Its most successful and important application is in the removal of the ovaries and Fallopian tubes for the cure of fibromyoma of the uterus, and its indications and method of performance for this purpose will be found in the article on UTERINE TUMOURS.

It has also been advocated and practised for the cure of hystero-epilepsy and insanity, when these conditions appear to be associated with the catamenia. It is, however, very doubtful whether this is a legitimate field; the results at present obtained certainly do not encourage its frequent use in these cases.

There are two well-marked conditions of the ovaries, the result of blood-changes and inflammation, which may occasionally, if they can be correctly diagnosed, not only justify, but demand oöphorectomy. Their causes and pathology have been but little studied at present.

In the one case the ovaries are found enlarged, distended with unruptured follicles or small cysts, and with the outer coat much thickened. This condition is probably the result of chronic ovaritis, the thickening of the external layer of fibrous tissue preventing the rupture of the follicles. The affected ovary will usually prolapse from its weight, the prolapse still further interferes with its circulation, it is constantly congested, and is liable to injury during defæcation, sexual intercourse, or from the treatment of inexperienced gynaecologists. So long as it does not become adherent a cure is possible. The treatment should consist in a careful regulation of the bowels, avoidance or sparing use of sexual intercourse, rest in the recumbent position during menstruation, the thorough application of the continuous hot douche night and morning, and counter-irritants applied externally to the skin of the abdomen on the affected side. Sometimes a watch-spring ring pessary, if it can be worn, will aid the cure by supporting the ovary. Small and continuous doses of perchloride of mercury are also useful.

If one or both ovaries, thus diseased, become fixed by adhesions to the bottom of the pouch of Douglas, and especially if the uterus retrovert and press upon them, nothing but oöphorectomy will give relief,

and some of the most satisfactory results of this operation will be met with in this class of cases. It is, however, only justifiable when every other method of treatment has failed, and the patient has become a complete invalid.

In the other condition, referred to above, the ovaries on removal are found to be small, hard, and shrivelled—in fact, cirrhused—the follicles having entirely disappeared. This may be in some cases merely a further stage of the condition we have been considering, but there is good reason to suppose that it may result without such intermediate state, from the blood-changes in some of the specific fevers, notably scarlet fever and measles, especially when these diseases attack the patient severely about puberty.

With the large chronically inflamed ovary menstruation is generally irregular, but is more often too frequent and too free, while with the cirrhused ovaries it is painful, scanty, and with long intervals, or it may be altogether absent.

The cirrhused ovaries are rarely displaced, and can often not be defined by the most careful bi-manual examination. They are often bedded in adhesions to the Fallopian tubes, to the side of the broad ligament, or to neighbouring structures.

Nothing in the way of medicine or treatment seems to relieve the dysmenorrhœa or amenorrhœa in these cases, and though oöphorectomy may be occasionally successful, it does not seem to yield such good results as in the previous class. This is not to be wondered at, because the large ovary is, from its size and surroundings, and from the constant enlargement without rupture of the follicles, a source of constant pain, whereas the cirrhused ovaries are not so often painful in themselves, but are a cause of indirect suffering from the imperfect performance of their functions.

It will be found a good rule, and one that should rarely if ever be broken, to refuse to perform oöphorectomy unless an ovary can be distinctly made out, by physical examination, to be in a diseased condition. Even then the operation should never be performed, unless the surgeon is convinced that all other possible means of cure have had a fair and sufficiently prolonged trial. The only points in the method of performing the operation which need be alluded to, as Ovariectomy is given in full detail, are—

1. Greater care in opening the peritoneum.

2. Special care in sewing up the wound, as, the parietes not having been stretched,

a weak cicatrix, and the chance of ventral hernia, are more likely than after ovariectomy, unless all the layers of the abdominal wall are accurately united.

3. The greatest care should be taken to remove all the ovarian tissue and the tubes close up to the uterus; it is therefore necessary to leave a short stump, and the ligatures must be tied tightly. If both ovaries are removed, both pedicles should be transfixed and tied, and the sponging completed, before the organs are cut away.

The after-treatment is exactly the same as in ovariectomy. When both ovaries and tubes have been closely and cleanly removed, the patient usually has a short metrostaxis within a day or two after the operation, and then entirely ceases to menstruate, and loses her sexual feeling. The rare cases in which a third ovary is present, and escapes detection and removal, may account for some apparent exceptions to this rule. Other exceptions are due to imperfect removal of ovarian tissue: a very small portion left behind, even on the distal side of the ligatures, will not only keep up menstruation, but will leave the sexual appetite; indeed, in some cases, a small remnant of ovarian tissue thus left, and probably irritated by the neighbourhood of the ligatures, seems to increase the sexual feeling.

A very occasional metrostaxis will occur in young women after the most complete oöphorectomy, but there is always the chance of a third ovary in these cases. When the ovaries have been very adherent, so that they have to be literally scraped out, menstruation may continue for a time unaffected, and the same phenomenon is observed in some cases in which papillomatous ovarian growths have to be enucleated; evidently very small portions of ovarian tissue are sufficient to stimulate the uterus. In married women, the probable loss of sexual feeling should be clearly put before both husband and wife before the operation is performed.

Most patients suffer, for a longer or shorter period, after the operation from the usual troubles of change of life, such as chills, perspirations, flushings, headache, and pains in the joints.

J. KNOWSLEY THORNTON.

OPHTHALMIA. See **CONJUNCTIVA**, Diseases of the.

OPHTHALMOSCOPY — the art of examining the interior of the eye with the ophthalmoscope. The optical conditions necessary for distinct vision are (1) transparency of the dioptric media of the eye

(cornea, aqueous humour, lens, vitreous humour); (2) accurate focussing, on the per-
 ceipient elements of the retina, of all rays
 passing through the pupil from the objects
 on which the attention is fixed. If the pupil
 remain widely dilated when a considerable
 amount of light is passing through it, we
 frequently see, and more especially when
 the eye is at the same time ametropic, or
 out of focus, that, instead of appearing black
 as usual, it is bright, and, as it were, shining
 with a yellow or yellowish-red light. When
 this is the case, we may observe that we
 are nearly in the line joining the source of
 light and the pupil. In other positions we
 see the pupil dark or black as usual. The
 ordinary black appearance is due to the
 fact that the head of the observer inter-
 cepts the rays, which would be reflected in
 the direction of his own eye.

The principle of the ophthalmoscope
 consists in bringing the eye of the ob-
 server in the axis of the cone of light which
 passes through the pupil of the eye ex-
 amined; when this can be done, it is evident
 that the conditions requisite for seeing the
 rays reflected from the interior of that eye
 are complied with. This was first done by
 Helmholtz, by reflecting light into the eye
 from the surface of a piece of glass, which
 being at the same time transparent, allowed
 some of the rays again reflected from the
 interior of the eye to pass into the observer's
 eye placed behind the glass, and by means
 of these transmitted rays the fundus became
 visible. A modification was soon intro-
 duced, by which the image obtained became
 more luminous and distinct. This consisted
 in making use of a metallic or silvered glass
 mirror, with a hole in the centre. The eye
 of the observer, placed at the back of the
 mirror close up to the hole, enables him to
 catch some of the rays reflected from the
 fundus of the eye into which the light has
 been thrown by the mirror, and in this way
 to obtain the desired image. This arrange-
 ment is that of the *ophthalmoscope mirror*
 as it is now used. Various forms are given
 to the mirror; thus it may be plain, con-
 cave, or convex, or the two surfaces of the
 silvered glass may have different curvatures,
 and these be again either homocentric or
 heterocentric; but the main points, so far
 as the mirror is concerned, are that there
 shall not be disturbing reflections from
 the two surfaces or from the sides of the
 aperture, both of which conditions are com-
 plied with by making the glass thin or by
 using polished metal.

Two methods of ophthalmoscopic ex-
 amination are in use—the *indirect* and the

direct, both of which have their advan-
 tages. (1) In the indirect examination,
 the ophthalmoscope, placed close to the
 observer's eye, is held at from 12 to 20
 or more inches from the eye to be ex-
 amined, at a few inches from which and in
 the line of the rays reflected from the eye,
 the observer holds a convex lens of $2\frac{1}{2}$ - to
 3-inch focus. When the mirror is so placed
 as to cast the light into the eye an inverted
 aerial image of a portion of the fundus
 oculi is found between it and the convex
 lens, and situated at or near the focus of the
 latter (according to the state of refraction of
 the eye). It is this image which forms the
 actual object of examination. In order that
 this aerial image may be seen distinctly, it
 is evident that the observer's eye, and with
 it of course the ophthalmoscope mirror, must
 at least be as far from it as the distance of
 the observer's near point.

(2) By the direct method a much
 greater magnifying power is obtained, but
 a smaller portion of the fundus is seen
 at one time, so that, for a topographical
 examination and for making a quick sur-
 vey of the back of the eye, the indirect is
 more satisfactory; indeed, it is but seldom
 that the use of the direct examination
 affords information of diagnostic importance
 which would escape detection by the more
 rapid indirect method. In examining by
 the direct method, the observer brings his
 own eye and mirror close up to the eye
 to be examined, in which case, if his own
 refraction be normal (emmetropic), he will
 receive on his retina an image of the fun-
 dus from all eyes the rays from any point
 of the back of which are parallel, or moder-
 ately divergent, on emergence—that is to
 say, from emmetropic, or not too highly hy-
 permetropic, eyes. To see the fundus dis-
 tinctly in cases of myopia, it will be neces-
 sary for him to place in front of the eye he is
 examining—or, more conveniently, imme-
 diately behind the aperture in the mirror of
 the ophthalmoscope, a concave lens suffi-
 ciently strong to convert the rays, which
 from points in the myopic fundus are con-
 vergent on emergence, into parallel or moder-
 ately divergent bundles. It is evident,
 then, that an ophthalmoscope to be used
 for direct examination is necessarily a little
 more complicated than that which will
 suffice for indirect examination, inasmuch
 as it requires the addition of lenses be-
 hind, or at any rate some arrangement
 by which lenses can be placed behind the
 aperture in the centre of the mirror. As
 ordinarily manufactured, it is fitted with
 a number of lenses, which can be brought

into position by some simple mechanical arrangement, and which enables the observer, on the assumption that both he and his patient are fully relaxing their accommodation, to ascertain the state of refraction of the eye he is examining.

A number of different forms of ophthalmoscope, with lenses capable of being moved into position behind the centre of the mirror—so-called 'refraction ophthalmoscopes'—are in use. Some of these are more fanciful and of less practical value than their inventors believe. The chief points to which attention should be given in selecting such ophthalmoscopes, besides those already mentioned, are that the mirror should be capable of being inclined to 30° , or thereabouts, to either side; that the aperture should not be very small, and should be placed as near as possible to the lens behind it; and that there should be a sufficient number of lenses of not greater than 1 D interval between each. With a properly constructed ophthalmoscope and considerable practice, a fair degree of approximation can be made to the degree of ametropia by the direct examination, provided always that the ametropia is not excessive.

The points to which special attention should be given in making an ophthalmoscopic examination are the following:—1. The degree of transparency of the dioptric media; 2. the condition of the optic nerve and vessels; 3. the condition of the fundus at and around the macula lutea and, 4. at the periphery.

The degree of transparency of the media is made out mostly by means of the mirror alone. The reddish reflex from the back of the eye obtained by throwing light into it, reveals, by its greater or less uniformity and clearness, whether or not any obscurity exists in any of the dioptric media. Sometimes, when slight and diffuse, an opacity may only first be recognised when an attempt is made by either method of examination to obtain an image of the fundus. Under such circumstances, the details of the structures otherwise visible at the back of the eye appear veiled, so that they are more or less indistinctly recognisable. Opacities, made out by using the mirror alone, may completely interrupt the reflex from the fundus, or do so only partially, here and there, and may be stationary, altering their position only with the eye, or movable ('floating opacities'). The complete opacities are mostly due to dense exudations in the vitreous, either inflammatory or hæmorrhagic, inflammatory exudations occluding the pupil, and advanced cataract. Extensive

exudations or effusions of blood into the anterior chamber are readily diagnosed by other means than ophthalmoscopic examination. *Partial* opacities, again, when not in the cornea or aqueous chamber, are to be found in the lens and vitreous. In the lens they are, practically, invariably stationary, and can be localised from the direction in which they alter their position with movements of the eyeball. As the lens lies anterior to the point of rotation of the eyeball, the change in position coincides in direction with that of the eye, and is more extensive the more anteriorly the opacity is situated. Opacities of the lens appear with the ophthalmoscope in various shapes as dark striæ, dots, or diffuse patches, according to the nature of the lenticular change. So, also, the track of a foreign body which has passed into the eye through the lens is easily detected, by the more or less dark area of interruption in the reflex.

Opacities of the vitreous are either stationary or floating, and assume many varieties of shape, density, and colouring, according to their origin and nature. If stationary, they alter their position in a direction opposite to that of the eye, unless when far forward, as in the case of the plastic exudations immediately behind the lens in some cases of inflammation of the ciliary body (cyclitis). Vitreous opacities appear punctiform, filiform, membranous, or in large irregular dark patches, which latter are often blood-clots, and not infrequently give a dark reddish reflexion. The colour of a large mass of blood, as well as of a growth in the vitreous chamber, is often more distinctly seen by placing the ophthalmoscope mirror at the side of the eye, instead of straight in front of it. Occasionally, in old-standing disease of the eye, the opacities in the vitreous are seen to sparkle with a metallic lustre, owing to the development of cholesterine in the particles of exudation (*synchysis scintillans*).

In examining the optic nerve, attention must be paid to the following points:—(1) Its colour, transparency, contour, and surface. (2) The size and condition of the arteries and veins. (3) The appearance of the structures immediately surrounding it.

1. The intraocular end of the optic nerve, the *papilla optica* or *optic disc*, is normally transparent, its fibres being divested of their opaque myeline sheaths in passing through the sclerotic coat, altered in this position to a fine close network of connective tissue—the *lamina cribrosa*. As the depth of the transparent portion of the papilla is greatest in the nasal half, that portion is

more highly coloured and less different from the adjacent retina than the other parts, especially the outer portion of the temporal half, all of which is paler than the nasal half. The colour of the nerve as a whole, as well as of its different portions, is subject to very considerable physiological variation. Mistakes are frequently made by not keeping this in mind. Pathologically, the colouring of that portion of the optic nerve which can be seen with the ophthalmoscope may be increased or diminished. It is increased owing either to increased vascularity or swelling, as in hyperæmia and optic neuritis. It is diminished owing either to diminished vascularity or to shrinking, displacement, or loss of substance, as in anæmia, optic atrophy, and glaucoma. The excessive pallor which it assumes in cases of atrophy is greatly owing to the strong white of the lamina cribrosa shining through. It must be remembered that, owing to the great amount of white light reflected from the lamina cribrosa, the colour of the nerve, as seen with the ophthalmoscope, depends a good deal upon the amount of light thrown into the eye; the stronger the light the paler does the nerve appear. Occasionally, masses of pigment, seldom extensive, are to be seen in the papilla as a physiological variety; they lie in the deeper layers of the nerve on a level with the choroid, so that the retinal vessels may be seen to pass over them from the nerve. In health, the margins of the nerve are sharply distinguishable from the surrounding tissues. This distinct outline is lost more or less completely in cases of neuritis, owing to the swelling and hyperæmia of the nerve, sometimes, indeed, so entirely that the actual position of the nerve itself is mainly recognisable from the position of emergence of the great vessels, or, when that point is obscured by the swelling, by the situation from which they appear to diverge. In rare cases, some of the optic nerve-fibres retain their myeline sheath for some distance into the nerve-layer of the retina. This condition also gives rise to the ophthalmoscopic appearance of an obliteration of the sharp margins of the papilla, but is easily recognisable from that caused by neuritis.

The surface of the nerve again is subject to varieties both in health and disease. As already mentioned, the outer portion is not so deep as the nasal, and it not infrequently happens that there is a funnel-shaped depression in the centre, or slightly to the temporal side of the centre, of the nerve. The extent of this depression, both in

depth and superficies, is very variable. It has received the name of 'physiological excavation of the papilla.' The ophthalmoscopic appearance of such a physiological excavation is that of a white disc, the absence of colour in which contrasts strongly with the other parts of the nerve, especially the portion lying to the inner or nasal side of the depression. Within this disc the vessels appear out of focus, but by selecting the proper lenses to place behind the ophthalmoscope mirror in the direct examination, they may be traced down to the bottom of the depression, converging to the point from which they bifurcate, and following exactly the walls of the funnel-shaped depression. On focussing accurately the bottom of the depression, the meshes of the lamina cribrosa are often distinctly visible. If the examination be made by the indirect method, and the convex lens be moved from side to side, the peripheral ring-shaped portion of the nerve appears to glide more or less distinctly backwards and forwards over the indistinctly visible vessels of the central disc, a parallax movement which shows that the latter are out of focus, owing to their lying at a deeper level than the rest of the surface of the nerve. Excavation of the optic nerve occurs also pathologically in glaucoma and optic atrophy. When it occurs in glaucoma, the whole cross section of the nerve gradually recedes, owing to the increased intra-ocular tension; the vessels are observed to bend sharply round the edge of the nerve, and to be pushed towards the inner side, the surface of the nerve appearing at the same time of a bluish-white colour, and giving the characteristic parallax, on indirect ophthalmoscopic examination, indicative of a depression. The vessels can not generally be traced down the side of the depression, but appear discontinuous from the edge to the bottom of the excavation, where, as the atrophy of the fibres caused by the pressure increases, the retiform structure of the lamina cribrosa becomes more and more distinctly visible. Excavations, in cases of optic atrophy, are less characteristic, though seldom likely to be confounded with true glaucomatous changes.

2. The central artery and vein branch, at various depths in the nerve, into two main trunks, which pass upwards and downwards, afterwards subdividing somewhat, and curving outwards round the region of the macula. The arteries are somewhat narrower and for the most part straighter than the veins, and appear with the ophthalmoscope lighter in colour, owing to the

difference in the colour of the blood and greater thickness of their walls. This latter circumstance gives rise also to a reflection seen as a white stripe along the arteries, and only very indistinctly marked in the case of the veins. The arrangement of the vessels is subject to physiological variation, and not infrequently there is to be seen a more or less distinct pulsation in one or more of the venous trunks lying in the papilla. Pathological changes are met with in the vessels, with respect to their position, size, configuration, and blood-current. As already stated, the pressure which leads to pathological excavation of the papilla, often causes a displacement of the vessels, pushing them more or less completely to the inner side. Both arteries and veins, or more frequently the arteries alone, may be much diminished in size in various atrophic processes, as in retinitis pigmentosa or other secondary and primary optic atrophies, sometimes so completely as to give rise to the appearance of mere threads. In neuritis optica the vessels, more especially the veins, are greatly swollen and tortuous, their perivascular spaces sometimes being loaded, and appearing as parallel whitish lines on either side. Aneurismal dilatation, as well as hæmorrhage around the vessels, is also met with as the result of pathological processes. A not very uncommon occurrence is a rhythmic pulsation in either the venous or arterial trunks. Venous pulsation is not generally pathological; but, when occurring over a large extent of the vessels, is due, most frequently, probably, to Graves's disease, or insufficiency of the tricuspid valve. Arterial pulsation is usually due to increased intraocular tension, and is therefore a frequent symptom in glaucoma, where it is almost invariably confined to the trunks or the papilla; a more extensive arterial pulsation is sometimes seen in Graves's disease, and along with aortic regurgitation. Three conditions—embolism of the central artery, thrombosis of the central vein, and hæmorrhage into the sheath of the optic nerve, produced by fracture through the foramen, cause a varying degree of interruption in the current through the retinal arteries and veins, which may often be distinctly recognised with the ophthalmoscope.

3. Immediately surrounding the disc there is usually seen a narrow white zone, the so-called scleral ring, the portion of the sclerotic immediately surrounding the nerve being seen, owing to the aperture in the choroid being larger than that in the sclero-

tic. Immediately surrounding the scleral ring, again, may be seen a ring of choroidal pigment, or, much more commonly, only a crescentic, or it may be one or more crescentic portions of such a ring, more often on the temporal side, where the choroid seldom lies so close up to the nerve as elsewhere. It frequently happens that the breadth of the scleral ring in this position is pretty considerable, owing to the same cause, and this occurs as a physiological variation independent of the state of refraction; but, when more than about one-third of the papilla in breadth, it is usually associated with some change or atrophy of the corresponding part of the choroid, and is most generally found in myopia, constituting the change which has received the name of *staphyloma posticum*, the importance of which has been greatly exaggerated. In high degrees of myopia the staphyloma posticum is seen to extend right round the nerve, though almost always most extensive at the temporal side. In glaucomatous excavation of the papilla the scleral ring disappears, the excavated nerve being surrounded by a more or less broad yellow ring, due to some degenerative change in the choroid.

In health the retina is transparent, so that the only structures which are visible in it are the vessels, which are to be seen dividing dichotomously all over except at the centre or region of the macula lutea, where there is a conspicuous absence of large vessels, the region being mainly supplied by fine twigs curving outwards from the papilla above and below it. These all converge towards the macula, without, however, being traceable right up to it. The distinctness with which the deeper structures of the choroid is to be made out depends upon the density of the pigment in the hexagonal cells, histogenetically belonging to the retina, but more strongly adherent to the choroid. When this pigment is very dense, it completely excludes any view of the choroid; otherwise a more or less distinct picture is obtained of the vascular system of that membrane, according as its own cells are more or less filled with pigment. With little pigment in the hexagonal cells and much in the choroid, only the larger choroidal vessels are visible, the variously shaped interspaces between which are darkly pigmented. With little pigment in both retina and choroid, the whole capillary system of the latter (choriocapillaris) is also recognisable. There is, therefore, a great difference possible in this respect in the ophthalmoscopic appear-

ance of the fundus in different individuals, the two extremes being met with in the negro and albino.

The retina is subject to various pathological changes, either as a whole or in its vessels and pigment-cells, the alterations being for the most part accompanied by changes in the choroid and nerve. A loss of transparency occurs whenever there has been a sudden disturbance in the retinal circulation, brought about by one of the causes already mentioned, the retina assuming an opaque, whitish appearance, due to œdema. This change takes place over a greater or less extent of the membrane, but is absent in the macula, owing to the retina in that situation being thinner, so that the normal red reflection is preserved there, giving the appearance, on ophthalmoscopic examination, of a bright red spot. The transparency of the retina is also more or less altered by inflammation (retinitis), when it at the same time becomes hyperæmic, and in some situations distinctly striated, owing to swelling of the layer of nerve-fibres. Detachment of the retina, if it has existed for some time, causes it to lose its transparency and to assume a greenish or bluish-white aspect. When recent, detachment of the retina is not always very easy to diagnose, owing to œdema of the undetached portion, the frequent cloudiness of the vitreous, and the retention of its transparency by the portion detached. When the pushing forward of a detached portion is at all considerable, it can generally be seen to lie out of focus, requiring a different glass behind the ophthalmoscope from that with which other parts are seen distinctly, to bring it prominently into view; thus the vessel becomes indistinct at the edge of the detached membrane, and can again be seen distinctly only by accurate focussing; in this way it is possible to diagnose the abnormal position. *See* VITREOUS, Diseases of the; RETINA, Affections of the. Different sized hemorrhages of various shapes are to be seen in the retina in certain affections of the blood, as in leucocythæmia and pernicious anæmia, or owing to inflammatory and degenerative changes in the vessels. The small extravasations are mostly flammiform, but larger ones assume all sorts of irregular shapes.

From what has already been said, it will be readily understood that choroidal affections often do not produce changes recognisable with the ophthalmoscope, unless they have, either from the first or subsequently, been of such a nature as to involve

the retinal pigment; thus, we may have an acute choroiditis existing, with little other ophthalmoscopic change than the opacity of the vitreous caused by part of the exudation having found its way into the vitreous chamber. As soon, however, as the hexagonal cells are invaded, the masses of exudation and degenerative changes which exist at the sites of inflammation come into view, giving rise to very different appearances. The exudations into the choroid may take place in large diffuse patches, producing the appearance of yellowish or white plaques, bordered in places, and here and there covered by masses of displaced and proliferated pigment, or they may occur in disseminated small patches of various shapes, and at different parts of the fundus. Often such changes first make their appearance at the equator, for which reason, as already observed, it is important to make careful examination of the peripheral portions of the fundus. Cases in which the retinal pigment is scarce, whilst the cells in the choroid are densely pigmented, give rise to such a curious mottled appearance that one is apt to consider the condition pathological. This is, however, only justifiable when different portions of the fundus present widely different appearances in this respect, or when, though little or no view of the choroid is obtained in some situations, it is distinctly visible in one or more localities; we may then assume that there has been some process leading to change or atrophy in the hexagonal cells, an assumption which can often be verified by proper subjective tests.

Choroidal changes are often limited to the region of the macula, especially in old people, so that an examination of that region should always be made when an amblyopic defect is unaccounted for by appearances elsewhere. It is often very difficult to get a distinct view of the centre of the retina, owing to the fact that the concentration of light on the macula causes great contraction of the pupil, besides which, the reflection from the cornea frequently adds to the difficulty. It is, therefore, necessary to use some mydriatic, the most convenient for such purposes being homatropine. In the form of retinal sclerosis or inflammation which has received the name of retinitis pigmentosa, there are generally to be seen, besides atrophic changes in the nerve and vessels, a number of bone-corpuse-shaped pigmentary spots, which may easily be made out to lie well into the retina. Their appearance is very characteristic, and is most frequently met with

in a ring-shaped distribution between the centre and equator.

With the exception of the scleral ring, to which reference has been made above, no portion of the sclerotic is visible with the ophthalmoscope in a healthy eye. A beautiful ophthalmoscopic appearance is given by a somewhat rare congenital defect, which consists in the partial absence of the choroid. In this condition of coloboma of the choroid the sclerotic is brought into view lying as a bright white membrane below the transparent retina, the vessels of which may be seen crossing it at various places. A defect of the choroid allowing the sclerotic to come into view is also met with as the result of accident—rupture of the choroid. The ophthalmoscopic appearances of this accident are at first frequently so veiled by the hæmorrhage accompanying it, and which destroys for the time being the transparency of the vitreous humour, that it is generally not until some time that a distinct view is obtained. The rupture generally takes place at the back of the choroid, in the vicinity of the nerve and macula.

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OPISTHOTONOS. *See* TETANUS.

OPTIC NERVE, Diseases and Injuries of the.—**CONGENITAL ABNORMALITIES.**—A. Not infrequently there is a very delicate veil of connective tissue over the central blood-vessels at their exit, and for a short distance beyond. Sometimes this condition is much exaggerated, rendering the disc decidedly pale, and obscuring the vessels.

B. Imperfect closure of the embryonic fissure in the optic cup and adjacent part of the pedicle leads to coloboma of the iris, choroid, or optic nerve-sheath, according to the part involved. The latter—coloboma of the sheath of the optic nerve—is comparatively rare. The main branches of the central vessels are seen to emerge near the upper edge of the disc-area, while the lower part, corresponding to the cleft in the sheath, is very pale and deeply excavated, with fine vessels curving round its margins. The appearances vary considerably in different cases, and the condition is frequently accompanied by coloboma of the neighbouring part of the choroid below.

DISEASES.—The optic nerve, with its retinal expansion, is a direct prolongation of the brain, and it will be well to bear in mind this relationship as serving, in some measure, to explain their peculiar liability to suffer in intracranial disorders. For the ophthalmoscopic appearances of the normal

optic disc and its variations, *see* OPHTHALMOSCOPY.

Pathology.—This nerve is peculiarly prone to suffer in affections of the central nervous system, in some forms of chronic poisoning, and in certain general disorders. Inflammation of an acute or chronic character may attack it at any point in its course, may affect its whole thickness or only a part of it, and may or may not lead to permanent atrophy, total or partial. Again, without recognised inflammation, the nerve may undergo degenerative changes resulting in a simple atrophy. Occasionally, the occurrence of an inflammation or simple atrophy of the nerve is intelligible enough, as, e.g., an optic neuritis in association with orbital cellulitis, or a simple atrophy subsequent to rupture of the nerve-trunk. Generally, however, the pathological process is most difficult to trace, and our knowledge must still rest largely on hypothesis. It is impossible, in the space at our disposal, to enter into discussions as to the relation between optic neuritis and intracranial disease, &c.; but the following facts should be remembered in connection with the exceptional vulnerability of this nerve.

1. From its development and structure the optic nerve is to be regarded as a direct prolongation of the central nervous system, and is therefore to be distinguished from ordinary cerebro-spinal nerves.

2. Their position and long course along the base of the brain render the nerves, commissure, and tracts liable to be affected in inflammation of the membranes in this locality and in cases of intraventricular pressure.

3. The sheaths of the nerve are derived from the membranes of the brain, the outer having also a connection with the periosteum lining the orbital canal. These sheaths are in close relation with one another by means of numerous connective-tissue processes throughout their course, and the innermost sheath enters intimately into the structure of the optic nerve, besides sending a special, large process to accompany the central blood-vessels, and run in the axis of the nerve. Ultimately, the sheaths join the coats of the eyeball at the optic nerve-entrance, where they are associated with the fibrous processes forming the lamina cribrosa. We thus have the possibility of a direct transmission of an inflammation, of the meninges or of the orbital periosteum, along the sheaths to the fibrous framework of the nerve itself; which latter may be attacked at the lamina cribrosa, at the en-

trance of the blood-vessels, at the optic foramen, or along its course in the orbit.

4. The inter-vaginal spaces of the nerve are in connection more or less intimate—(a) With the meningeal cavities of the brain; (b) with one another; (c) with the lymphatic spaces around the nerve-fibre bundles; (d) with the lymph-channels of the surrounding orbital tissue. The fluid circulating in the lymphatic system of the nerve may therefore contain inflammatory material, primarily derived from within the cranium, or possibly from the orbital tissue, and thus an inflammation may be communicated to the nerve framework. Again, serous fluid or blood effused in the meningeal cavities may find its way into the sheath-spaces, and injure the nerve by direct pressure.

5. The absence of a primitive sheath possibly renders the nerve-fibres more vulnerable in the post-bulbar portions, while, in the intra-ocular portion of the nerve, the naked axis-cylinders are directly exposed to the action of the lymph.

6. The narrowness of the optic foramen is liable to cause further constriction in an already existent œdema, while, in like manner, the disposition of the lamina cribrosa tends to promote a similar effect by its pressure on the blood-vessels and lymphatics. Finally, it must be borne in mind that we can detect inflammatory and atrophic changes in this nerve, which might readily escape notice in other cranial nerves.

1. INFLAMMATION OF THE OPTIC NERVE.

Pathology.—The optic disc or papilla, or intraocular end of the nerve, is the part commonly affected; and then the inflammation generally stops abruptly at the lamina cribrosa, but may exceptionally extend a short way beyond this structure as an 'ascending neuritis.' In other cases, an inflammation, beginning in the nerve-trunk, may travel downwards and involve the papilla secondarily, constituting what is called a 'descending neuritis.' 'Papillitis' is a useful term for the condition in which the papilla is involved, the expression 'optic neuritis' being retained as the generic term for inflammation of any part of the nerve. When the inflammation attacks the nerve-trunk behind the eyeball, we speak of it as a 'post-bulbar neuritis.' In many such cases no papillitis is ever manifest. All forms of neuritis are probably interstitial in nature, yet the early stage of a severe papillitis is unaccompanied by affection of the connective-tissue, the changes merely consisting of venous

hyperæmia, œdematous infiltration, and hypertrophy of the axis-cylinders. If the inflammatory process stop short at this stage, and recovery take place, we may ultimately get a healthy disc and retention of normal vision.

In an interstitial inflammation we have, at first, cellular infiltration and swelling of the vascular connective-tissue framework, and, subsequently, hypertrophy of this structure; so that the nerve-fibre bundles become reduced in size from pressure, and either finally disappear or undergo grey degeneration (post-papillitic atrophy). In the later stage of a papillitis, the walls of the blood-vessels are thickened, the adventitia being increased, and the middle coat of the arteries often considerably sclerosed. The surrounding retina is frequently affected for some distance, changes of a similar nature to those in the papilla occurring in the nerve-fibre layer (papillo-retinitis). As previously observed, optic neuritis does not necessarily affect the nerve in its entire thickness. In some cases the periphery is mainly involved, and we have the condition known as 'perineuritis.' In other cases, the inflammation is limited to the central part of the nerve affecting the fibres going to the fovea centralis and neighbourhood, as in the variety called 'axial neuritis.' As a rule both nerves are affected, and similarly, though not necessarily to the same degree, nor at the same time. Unilateral optic neuritis is generally dependent on a local cause, such as orbital cellulitis; but it may also occur in association with intracranial tumour, &c.

Ophthalmoscopic Appearances.—We must be extremely cautious in diagnosing positively the slightest departures from the normal vascularity of the papilla, since its colour varies considerably in health in different individuals, and it is also subject to temporary hyperæmia from vasomotor influences. It is always desirable to employ the direct method of ophthalmoscopic examination (*see* OPHTHALMOSCOPY); but especially so when the apparent changes are insignificant; and we must invariably examine both eyes. The condition called 'active hyperæmia' is recognised by a slightly increased, general vascularity of the papilla, its tint being of a more pronounced red than is normal, but the relative size of arteries and veins remaining unaltered. The edge of the disc may be less sharp than usual; but it is not obscured, and there is no swelling. We find it as a result of prolonged exertion of the eyes by

artificial light, also in muscular or accommodative asthenopia, and from the irritation of foreign bodies, &c. In 'passive congestion' of the papilla we not only have increased redness, but also dilatation of the veins, the arteries being of normal size or slightly diminished. Between a simple congestion, with the characters just mentioned, and a fully-developed papillitis or 'choked disc' there are many gradations, marked by more or less swelling, blurring of the edges, and obscuration of the larger vessels. These gradations may simply be stages in the development of a high degree of papillitis, or any one of them may be the final condition where the affection of the papilla is of less severity.

In advanced papillitis the appearances are the following:—The edge of the disc is obscured and, while its general vascularity is greatly increased, there is a loss of translucency, with a greyish haze dulling the usual bright reflex. The whole papilla is distinctly swollen above the level of the adjoining retina, and the physiological cup is obliterated. Numerous straight vessels radiate from it on every side, coursing over its obscured edge. The larger vessels, especially the arteries, are frequently hidden at their origin on the papilla, and again in their course over it or just outside it. Frequently, small hæmorrhages occur either on or in the vicinity of the disc. Smooth, opaque, white spots occur on the disc or on the surface of the adjoining retina, concealing completely what they cover. The veins are enlarged, dark and tortuous, and the normal light-streak is absent. The arteries are usually somewhat narrowed. The retina, especially near the disc, is frequently cloudy over smaller or larger areas. The swelling of the papilla and the obscuration of its margin are to be explained by the action of several distinct factors—viz. vascular congestion, œdema, changes in the connective-tissue (swelling and proliferation of nuclei), escape of leucocytes, and degenerative changes in the nerve-fibres, accompanied by swelling and irregular enlargements. The striation near the margin of the disc is due to the presence of dilated vessels, running between the swollen nerve-fibres. The increased vascularity is at first inflammatory, but, later, it is partly owing to secondary interference with venous return; this latter is also the cause of the enlargement and tortuosity of the veins, and of the occurrence of the hæmorrhages. The opaque white spots are due to fatty degeneration of the nerve-fibres, and to aggregations of leucocytes.

As the papillitis diminishes, we find the redness of the papilla disappearing, while the swelling becomes reduced both in height and extent. The veins may, for a time, be more distended than before, but generally all the vessels are ultimately much narrowed. The edge of the disc again becomes distinct, the outer margin coming first into view. Around it there is frequently a pale zone, the result of changes in the retinal pigment. The disc itself is opaque and woolly-looking at first, but it gradually becomes smoother; its surface is occupied by newly-formed fibrous tissue which conceals the lamina cribrosa. In the stage of atrophy, the disc is usually of a brilliantly white colour, and the larger vessels are frequently bordered by opaque white lines. In cases of post-bulbar neuritis, the resulting atrophy is frequently the first ophthalmoscopic sign of the disease, but occasionally we have simple passive congestion or even considerable papillitis preceding the atrophic condition.

Symptoms.—Not only do we usually have no ocular pain or photophobia, but there may not even be any complaint of loss of vision. Indications of intracranial disease often lead us to examine the eyes, and thus to discover well-developed ophthalmoscopic signs of neuritis, in cases where there have been no local symptoms. Vision may remain perfectly good for some time; indeed, in exceptional cases, papillitis may occur and disappear again without its ever being impaired. Usually, however, loss of sight is a prominent symptom. It sometimes occurs rapidly, but never suddenly, and one eye is generally attacked a little before the other. If amblyopia occur quickly in an early stage of the papillitis, it is usually not due to the inflammation, but to pressure of a tumour or distended third ventricle on the chiasma or optic nerve. The form of the amblyopia varies according to the kind of the neuritis. In that due to an ordinary papillitis we have a gradual failure of central vision, with progressive diminution of the visual field from the periphery. The contraction usually begins on the nasal side, extends gradually all round, and, after the fixation point has been invaded, we may still have a small eccentric outer field. The colour vision in such a case may be lost out of proportion to the amblyopia, but the kind of failure is very irregular. In many cases of post-bulbar neuritis—in the axial form for example—we have the amblyopia first appearing as an impairment of central vision, while the periphery of the field re-

mains perfect. The loss of colour vision is here characteristic; the power of distinguishing red and green in a small central area being often lost in the very beginning of the affection. In some of the post-bulbar cases there is deep-seated pain in the orbit, excited or aggravated by pressing the eyeball backwards.

Causes.—Intracranial disease is by far the most common cause of papillitis. All tumours of the encephalon, irrespective of their nature, position, or size, are apt to produce it; but it is relatively rarer in tumours affecting the cortical motor area and the medulla, and most frequent in those of the cerebellum and base. We also find it in association with meningitis (especially traumatic and tubercular basilar), with cerebral abscess, and sometimes with chronic cerebritis without gross lesion. Injuries to the head may cause optic neuritis either through meningitis, effusion of blood (within the skull or within the nerve-sheath), hernia cerebri, or possibly through a laceration of the brain. It occasionally accompanies internal hydrocephalus, or aneurism of the internal carotid artery within the skull. In many orbital affections we are liable to get optic neuritis: (*a*) in orbital tumours, especially when situated in the immediate vicinity of the nerve; (*b*) in intraorbital inflammation, such as periostitis and caries of the walls, orbital cellulitis and erysipelas, whether traumatic or idiopathic; (*c*) in congenital malformation and hyperostosis of the skull, from narrowing of the optic foramina. In (*a*) there is usually protrusion of the eyeball; in (*b*) the papillitis is seldom of high degree; in both (*a*) and (*b*) the neuritis is nearly always one-sided. Papillitis has also been observed in association with acute myelitis, and in cases of injury to and caries of the spine in the cervical region.

Occasionally, we get papillitis occurring alone in cases of Bright's disease, but usually we have here a peculiar form of retinitis in combination with it. In chlorosis, and in progressive pernicious anæmia, we may meet with papillitis or papillo-retinitis, and also, more rarely, in leucocythæmia. In the anæmia following repeated large losses of blood, for example in hæmatemesis, papillitis has been described, but more commonly we get post-bulbar neuritis in such a condition. In these latter cases, the neuritis has been ascribed to the hydræmia, which according to Cohnheim may in itself excite inflammation in the vascular walls. Papillitis occasionally occurs in association with menstrual disturbances, such as sudden suppression or

habitual irregularities, and at the climacteric period. Acquired syphilis may be the cause of optic neuritis, either through meningitis or a gummatous growth, the latter being situated either within the skull, at the optic foramen, or on the nerve-trunk; the neuritis is mainly post-bulbar, and generally one-sided when the gumma is in one of the last two situations. A temporary 'hyperæmia' of the papilla has also been described as occurring in a considerable percentage of cases of syphilis during the secondary stage, attributed to a 'cerebral irritation or hyperæmia.'

In diabetes mellitus we get an axial neuritis, and, from the similarity of the symptoms in chronic poisoning by lead, alcohol, tobacco, and bisulphide of carbon, a similar affection of the optic nerve probably also exists in these latter affections. In the more acute cases of poisoning by these agents, slight papillitis or simple congestion of the papilla may be observed. Papillitis or post-bulbar neuritis sometimes occurs in patients suffering from acute exanthematous diseases (typhus fever, scarlatina, variola) and from malarial fevers. An acute post-bulbar neuritis or papillitis without definite known cause is occasionally met with. A certain number of such cases has been ascribed to a rheumatic periostitis at the optic foramen or to rheumatic inflammation of the nerve-sheath, in as far as there is a history of the arthritic diathesis, and often of a chill preceding the ocular symptoms. Other obscure cases seem due to an hereditary predisposition, and occur usually about the age of twenty, and almost exclusively in males. Optic neuritis is sometimes merely caused by an extension of an inflammation from a neighbouring tissue in the eyeball, and it has also been observed in an early stage of sympathetic inflammation, before the occurrence of iritis.

The *prognosis* in all cases of optic neuritis must be guarded, in reference to the final condition of the vision. The ophthalmoscopic appearances presented are of less service to us, in this respect, than a knowledge of the cause of the disease. We may have a papillitis with good vision leading ultimately to complete atrophy and blindness; while again, we may have a papillitis with the barest perception of light (as in occasional post-bulbar cases), followed by almost perfect recovery of sight. The prognosis is relatively more favourable where the cause is removable or amenable to remedies; thus, cases dependent on syphilis, menstrual disturbances, or anæmia may

recover without serious permanent changes under early suitable treatment. Similarly, an axial neuritis from chronic poisoning by tobacco, alcohol, &c., is speedily checked by removal of the cause; but the impairment of vision may remain, if atrophy of the affected fibres has already taken place.

Treatment.—The cause of the neuritis must if possible be removed, or attacked by the remedies most likely to prove serviceable. Where not contra-indicated or manifestly useless, mercury and iodide of potassium should be employed as a matter of routine, the latter being given in full doses. Rest in its widest acceptance is to be insisted upon. The direct treatment of the neuritis itself is unsatisfactory. Dry or wet cupping by means of Heurteloup's artificial leech to the temple, and blisters to this region or behind the ear may be tried. The application of ice to the forehead has also been recommended.

2. ATROPHY OF THE OPTIC NERVE.—

Pathology.—Whether the atrophy be the result of changes within the eyeball or behind it, the nerve is invariably affected ultimately in its entire length. The nervous elements of the trunk are involved in all true cases, and there is a corresponding loss of function. The histological condition of the atrophied nerve varies somewhat, according to the nature of the pathological process producing it, and different appearances may be presented in sections through different parts of the same nerve-trunk. Thus, in *atrophy the result of a neuritis* we find the usual post-inflammatory changes at the seat of the inflammation, while the rest of the nerve may present the appearances found after a simple or non-inflammatory atrophic process. As previously mentioned, neuritis leads to hypertrophy of the interstitial connective tissue; the consequent contraction of the meshes in which the nerve-fibre bundles lie subjects the latter to pressure, interfering at first with their function, and ultimately with their vitality. The nerve-fibres involved finally either break down and are removed, or they undergo grey degeneration; in the former case, the diameter of the nerve is much reduced from contraction of the fibrous tissue.

In the case of a neuritis at or near the intraocular end of the nerve, the walls of the central blood-vessels are thickened, and their lumen is diminished—partly in consequence of this change in their walls, but mainly from the pressure exerted by the hypertrophied connective-tissue. In *simple atrophy* there is seldom much increase of connective-tissue. The nerve-fibres lose

their white medullary sheath by a process of granular fatty degeneration, while the axis-cylinders are usually retained, but converted into fine indistinct fibrils. There is, consequently, little change in the size of the nerve, which presents the appearance of a translucent, grey, gelatinous-looking cord. This 'grey degeneration,' as it is called, is the most common form of simple atrophy. According to some authorities, this degeneration is really dependent upon a 'medullary neuritis.' It may be *diffuse*, affecting the whole nerve uniformly; or *insular*, and varying much in extent in different sections. Occasionally, however, we find considerable thickening of the connective-tissue framework due to a sclerosis, which, though not clearly traceable to an inflammation, is probably the result of a very chronic form of neuritis. In other cases of simple atrophy, the smaller blood-vessels of the nerve-trunk are found immediately surrounded by masses of a peculiar, gelatinous-looking material, between which lie the degenerated nerve-fibres. There is little increase in the connective-tissue in this form, but the normal arrangement of the trabeculæ is destroyed. In the great majority of cases both nerves are affected, though one may be considerably in advance of the other. Unilateral optic atrophy is to be explained by the one-sided nature of the preceding inflammation or other local cause.

Causes.—All cases of atrophy of the optic disc may be divided broadly into two great classes—(a) *inflammatory* and (b) *non-inflammatory* or *simple*. (a) Those due to inflammation are traceable either to a papillitis, a post-bulbar neuritis, or to an inflammation of the choroid or retina. (b) Simple atrophy may be primary or secondary. The *primary* form is usually the result of a grey degeneration, commences independently of any local cause, and is characterised by the occurrence of visible atrophic changes consentaneously with gradual failure of vision. In the *secondary* form, the loss of vision precedes the atrophy. *Primary* atrophy not infrequently occurs in association with disease of the central nervous system, especially with locomotor ataxy, but occasionally also with cerebral atrophy, mania, general paralysis of the insane, congenital idiocy, disseminated sclerosis, and lateral sclerosis of the cord. When found uncomplicated with other nerve-lesion, the remote causes assigned are the same as those which are given for the occurrence of grey degeneration in the central nervous system; and it would therefore seem probable that, due to the

action of certain causes, grey degeneration may occur independently in the brain, spinal cord, or optic nerves, and may be confined to one or other of these situations. Accordingly, we find male adults of the neuropathic disposition, from thirty to fifty, predisposed to this form of atrophy. The more immediate causes mentioned are severe bodily fatigue and hardships, especially exposure to cold and insufficient nourishment, grief and anxiety, mental excitement and exhausting brain-work, irregular habits of life, sexual excess, &c. Frequently no cause can be assigned.

The *secondary* form of simple atrophy includes all those cases where an interruption of conductivity in one part of the nerve leads to subsequent atrophic changes in the remainder, as in cases of injury where the nerve is cut across or torn through. Secondary atrophy may also arise from interrupted blood-supply (as from embolism), and from mechanical pressure (as from tumour, inflammatory exudation, bone-spicules, foreign bodies, &c.). Strictly speaking, the changes in many of the inflammatory cases are also of this nature; a localised neuritis leading to secondary atrophy in the rest of the nerve-trunk. Syphilis is a productive cause of optic atrophy and may induce any of the inflammatory forms above mentioned, or may lead to a secondary atrophy (as from the pressure of a gummatous exudation at the optic foramen, &c.). We frequently also get a specific history in cases of simple grey degeneration.

Ophthalmoscopic Appearances.—All forms of optic atrophy are recognisable by the ophthalmoscope sooner or later, inasmuch as the intraocular end of the nerve is always ultimately involved. The elements of the optic disc which undergo the atrophic change, are the nerve-fibres and the capillaries. Atrophy of the capillaries is to be diagnosed by the pallor produced, while nerve-fibre atrophy is ophthalmoscopically recognisable when an atrophic excavation exists. This latter, however, is often absent, since the space formerly occupied by nerve-fibres may be filled, or more than filled, by connective-tissue growth. We judge of the atrophy chiefly, therefore, by the *colour*, and much caution must be exercised in the observation, as the disc varies considerably in this respect, in different individuals, within physiological limits. It is particularly unsafe to diagnose pathological pallor of part of the disc, unless the vision be correspondingly affected. The colour of the atrophied disc may be white or grey,

according to the amount of fibrous tissue present. Not infrequently it is of a bluish or greenish tint, probably from the presence of a thin film of connective tissue in front of its surface. Variation in tint alone is generally inadequate for a conclusion as to the causation of the atrophy, in so far as similar anatomical changes in the nerve may be the result of a neuritis and of a simple atrophy.

The *excavation* in atrophy comes quite up to the margin of the disc all round, and is to be recognised by a change in the level of the vessels. It is never very deep, and slopes gradually backwards from the edges, so that the condition might be termed 'saucering' in contradistinction to the deep, steep-sided 'cupping' found in chronic glaucoma. Its occurrence and its depth are determined—(a) by the size and form of a previously existing physiological cup; (b) by the degree of wasting of the nerve; (c) by the amount of new connective-tissue formed; and (d) by the contraction which has taken place in this latter. At the bottom of the 'saucer' the lamina cribrosa may be visible over a large area, or it may be quite concealed by the newly-formed tissue. Usually, the edge of the disc is well-defined, and the normal scleral ring is traceable all round. The central retinal vessels are in some cases much diminished in size; in others only very slightly, if at all. Apart from cases of embolism, the reduction may be caused by changes in the vascular walls, pressure on the artery from connective-tissue hypertrophy, or by atrophic changes, in the inner layers of the retina, interfering with the circulation through the larger branches which run there.

In the post-papillitic form of atrophy, the disc is usually white; its margin is distinct, but often irregular-looking from a loss of pigment due to choroido-retinal changes; the central vessels are often bordered by opaque white lines, and are considerably reduced in size; the excavation is absent or slight, and the lamina cribrosa is invisible. In the atrophy consequent on choroido-retinal changes, the disc has generally a peculiar opaque, yellowish-red, 'waxy' appearance, and the retinal vessels are greatly diminished in size and sometimes in number. In the partial atrophy from axial neuritis, the pallor is confined to the temporal half of the disc. For a description of the form of atrophy due to increased intraocular tension, see GLAUCOMA.

Symptoms.—The most prominent symptom in cases of optic atrophy is failure of vision. The nature of this failure has been

already described in cases of atrophy secondary to neuritis. In atrophy from choroiditis and retinitis the failure is usually gradual, central vision often remaining fairly acute while the rest of the field has become amblyopic. In the secondary form of simple atrophy the vision often fails suddenly; sometimes only one-half of the visual field is lost, as in some cases of pressure on the chiasma. In primary atrophy, the loss of vision begins gradually and proceeds slowly and continuously. Besides the central failure, there is marked contraction of the visual field, sometimes occurring in a uniform, concentric manner, but more frequently in the form of sector-shaped defects, usually situated above and to the outer side of the fixation point. Affection of the colour-sense is almost constant, green being generally the colour first confused, while later, perception fails for red, blue, and, lastly, yellow. In the final stage of atrophy all colour-distinctions are lost, but there is no constant relation between the degree of the loss of colour-sense and the amount of the amblyopia. The pupils are usually wide in post-papillitic atrophy, small in spinal cases, and often of medium size in other forms. *See* AMBLYOPIA; AMAUROSIS; PERIMETRY.

The *prognosis* is unfavourable in all cases of true optic atrophy, but it is relatively less so where the atrophy is dependent upon some cause which is either removable, or which may pass away spontaneously. In some of the post-papillitic cases, also, considerable improvement takes place, if the sclerosing process do not lead to excessive pressure on such nerve-fibres as may have escaped destruction by the inflammation. In very exceptional cases we may get a restoration of normal vision under treatment, the disc remaining in the condition of white atrophy. In marked contraction of the visual field, and in cases of long-standing amblyopia, little or no improvement is to be expected. In cases of primary atrophy, almost complete blindness usually occurs in from one to three years.

Treatment.—Where the atrophy is dependent on some general condition or toxic influence, the treatment must be regulated accordingly. Nervine tonics are said to be occasionally useful. Where the atrophic process has not gone too far, the continuous current is sometimes beneficial. One pole should be applied over the closed eyelids and the other over the supra-orbital nerve, the current being broken pretty frequently and the poles transposed. The smallest number of cells which gives the physiological light-flash on making and breaking the circuit

should be employed, and the whole sitting should last about five minutes and be repeated daily for at least a month. If no improvement take place in this time, either in central acuity or in visual field, this treatment may be abandoned. If any marked benefit result, the current should continue to be employed at intervals. The patient is quite capable of carrying on the treatment for himself, after having once been properly instructed.

TUMOURS OF THE OPTIC NERVE.—The intraocular end of the nerve may be the seat of large colloid outgrowths from the vitreous lamina of the choroid. It may also be affected secondarily in sarcoma of the choroid, or in retinal glioma, the former spreading along the sheath and fibrous framework, the latter in the medullary substance of the nerve. The nerve-trunk (including its inner sheath) may be the original seat of tumours, or it may be involved secondarily by the extension of growths arising in the outer sheaths or in the orbital tissue around. The most common form of tumour proper to the nerve is the myxo-sarcoma. It leads to proptosis, papillitis or simple atrophy, and early blindness; the movements of the globe are usually good, and there is little or no pain. The intracranial part of the nerves and the chiasma are especially liable to gummata, and the chiasma may also be the seat of a deposit of cheesy tubercle. In most cases of tumour of the optic nerve, excision of the eyeball and tumour will be required. *See* EYEBALL, Excision of the; ORBIT, Tumours of the.

INJURIES TO THE OPTIC NERVE.—The optic nerve may be injured in any part of its course, either as the result of a blow, stab, gunshot wound, or fracture of the sphenoid bone. A powerful blow on the side of the eyeball may cause the nerve to be torn away at its entrance into the globe. A stab or thrust into the orbit may cut or tear the nerve; or, again, may merely bruise it, cause an extravasation of blood within its sheath, or sever the central vessels outside its trunk. If a foreign body penetrate deeply, it may produce a fracture of the orbital walls, not infrequently breaking off and forcing backwards the clinoid process of the sphenoid bone, and thus leading to injury of the nerve. Similarly, gunshot wounds may implicate the nerve either in its orbital or intracranial course, and pellets or fragments of metal may penetrate the eyeball and become embedded in the papilla. Fracture of the base of the skull, as from a fall or severe blow on the head, occasionally causes injury to the optic nerve at the

optic foramen, or behind it if the clinoid process be displaced. Sudden complete blindness of the corresponding eye is usually the result of any severe injury to the nerve. If the solution of continuity be complete, permanent blindness is the consequence; if incomplete, we may get restoration of vision in part of the field. If the nerve be simply bruised or pressed upon, sight may be restored; but secondary changes may occur in such a case, leading to ultimate atrophy. The ophthalmoscopic appearances differ according to the position of the injury. If the central artery be cut or torn through, we find changes in the fundus similar to those met with in embolism of the central artery. In other cases, the disc remains normal in aspect until the atrophic process reaches it, when it gradually assumes the appearance of an ordinary secondary atrophy with normal vessels. The treatment of the recent injury must be based on general surgical principles. Later on, if the continuity of the nerve has been preserved, the measures recommended above in optic atrophy may be of some avail.

R. MARCUS GUNN.

ORBIT, Diseases of the.—ABSCCESS OF THE ORBIT may be caused by blows on the eye or the adjacent parts, causing an effusion of blood into the orbital cellular tissue; or by any violence producing fracture of the orbital walls; or by penetrating wounds of the orbit; by the lodgment of a foreign body in the cellular tissue of the orbit; or by the extension backwards of a suppurative inflammation of the lids or of the tissues in immediate contiguity with the eye, no matter how induced. Orbital cellulitis, brought on by any cause, may terminate in abscess of the orbit. Caries, necrosis, or orbital periostitis may lead to abscess of the orbit.

Abscess of the orbit may be either *acute* or *chronic*.

ACUTE ABSCESS OF THE ORBIT is marked by the rapidity with which the inflammatory symptoms are developed—deep-seated pain in the orbit extending around the brow, worse at one time, better at another, but never absent, and steadily increasing in severity. Any pressure on the eye, or even moving it, aggravates the pain. The eyelids become red, shining, and oedematous, and the conjunctivæ of the lids and globe vascular, swollen, and chemosed. The eye now begins to protrude slightly beyond the level of the other, and this protrusion increases with the inflammatory exudations until, at last, the pus makes its way to the

surface. The displacement of the eye is usually not directly forwards, but more or less downwards and outwards, or downwards and inwards, according to the part of the eye on which the abscess presses. With the increasing protrusion of the globe the sight may become impaired, from the strain which is exerted on the optic nerve. The orbital fold of skin above the lid becomes obliterated, and the upper lid so swollen and stretched in front of the bulging eye that it cannot be raised by the patient. Over the most prominent part of the swelling a careful examination with the fingers will detect fluctuation. The most usual spot for the pus to point at is rather to the inner side of the interval between the supra-orbital ridge of the orbit and the upper border of the globe. Occasionally, the suppuration is more or less confined to one or other side of the orbit, and it may then point at either the inner, outer, or lower border of the eye. When the abscess is small, there may be little or no displacement of the eye. With all these local symptoms there is always considerable constitutional disturbance. The skin is hot and dry, the patient has occasional rigors and frequently night sweats, he is restless, and his sleep is broken from pain.

CHRONIC ABSCESS of the orbit is distinguished by the slowness of the development of its symptoms, and frequently by the absence of any severe pain. It often happens that the patient does not even seek advice, until an increasing protrusion of the eye with some diminution of vision excites alarm.

The diagnosis of chronic abscess of the orbit is sometimes difficult, and it may be confounded with a sarcoma or some soft orbital tumour, the elasticity of which closely resembles fluctuation. When there is doubt, an exploratory incision should be made into the tumour, and the surgeon should be prepared to act at once on the information it will afford him. If it be an abscess, the incision should be enlarged sufficiently to give free exit to the pus; but if it should prove an orbital tumour, it should, if practicable, be removed without any further delay.

Treatment of Orbital Abscess.—As soon as it is clear that pus has formed, a free opening should be made into the orbit for its escape. The site for making the incision should be that spot where there is the most distinct swelling and fluctuation, and where the pus has a tendency to point. In making the incision into the orbit, it is a wise precaution to place one finger of the

left hand on the lid so as to feel the globe, and to pass the knife between the nail of the finger and the edge of the orbit, as, if the incision is carelessly made, it is quite possible to wound the eye. The best knife for the purpose is a Beer's or Sichel's cataract knife, as the point is very sharp and the blade very thin, and with it the incision can be made easily and with safety. After the incision has been made and the pus allowed to escape, a strip of oiled linen should be inserted a short distance into the wound, to prevent the lips uniting; or a small india-rubber drainage-tube may be placed in the wound. A warm linseed-meal poultice should then be applied. The strip of linen or the drainage-tube should be changed daily for two or three days, when they may be removed. It is only necessary to continue the linseed-meal poultice for about forty-eight hours, when a fold of lint, soaked in a solution of carbolic acid about 1 part in 100 of water, may be applied and covered with oiled silk. In most cases the cavity of the abscess soon closes, and the patient makes a good recovery. It occasionally happens, however, that the wound from the incision only partially closes, and a long sinus remains, from which a slight purulent discharge continues to drain. When this is the case, and when no fragment of necrosed bone can be detected by a probe to account for it, the use of a stimulating injection, such as Zinc sulphat. gr. ij. ad f3j., or Zinc chlorid. gr. j. ad f3j., thrown into the sinus with a glass syringe twice a day, will often prove of great benefit. If, however, a portion of dead bone is felt with the probe, time must be given to allow of its becoming detached, or at least partially loosened from the living structure; and then, after enlarging the orifice of the sinus, it may be removed with a pair of fine sequestrum-forceps, first using, if necessary, a gouge or an elevator, or a pair of fine cutting bone-forceps to separate any portion of bone which may be holding it.

PERIOSTITIS OF THE ORBIT may occur in two localities—(1) in the circumferential ridge of the orbit, and (2) in the walls of the orbit.

(1) When the ridge of the orbit is the part affected, the periostitis is generally due either to a blow on the edge of the orbit, or to some constitutional defect in the patient, as struma, when a portion of the bone, or of the periosteum covering it, without any apparent cause inflames. In either case an abscess forms, which continues for a long time to discharge a little pus and gradually contracts to a sinus, at the bottom of

which a piece of necrosed bone may be felt with a probe. Ultimately a scale of bone is exfoliated and the part heals, leaving a depressed scar, which is adherent to the subjacent bone.

(2) Periostitis of the walls of the orbit is generally *chronic*, and due to syphilis, although it undoubtedly may arise from injury, such as penetrating wounds of the orbit or foreign bodies within the orbit. Syphilitic periostitis of the walls of the orbit usually leads to the formation of nodes or the effusion of lymph beneath the periosteum. These nodes are not common, but when they do occur they often suppurate, and a portion of the subjacent bone either exfoliates or becomes carious. The most frequent position of a syphilitic node adjacent to the orbit is on the frontal bone, just over the brow, and rather to the outer side.

Acute periostitis of the orbit rarely occurs, but when it does it is generally due to injury—either blows, possibly causing fracture of the walls of the orbit; or penetrating wounds; or the lodgment of foreign bodies in the orbit.

Treatment.—As chronic periostitis which is not due to injury is almost invariably dependent on syphilis, in many cases dating back many years, the most useful medicine is the iodide of potassium, which should be given in the first instance in doses of from gr. iij. to gr. v. three times a day; but if these fail to do good, the dose may be increased to gr. viij. or gr. x. To relieve pain and favour the absorption of the effused lymph, an ointment of Extract. belladonnæ gr. lx., Unguent. hydrarg. 3vij. may be rubbed into the brow daily. If the pain be very severe, opiates may be given at night, or, if preferred, a subcutaneous injection of from gr. ¼ to gr. ½ of the acetate of morphia. If these remedies fail, the following mixture may be ordered—Hydrarg. perchlorid. gr. j.; Potassii iodid. gr. lx.; Tinct. calumbæ f3ij.; Aquæ destillat. ad f3vj. Dose—Two teaspoonfuls in a wineglass of water three times a day.

If the node within the orbit should soften and pus be formed, an opening should be made to give vent to it; and if a chronic discharge continue, and this be found dependent on a piece of dead bone not yet detached, the sinus should be syringed out once or twice a day with a weak solution of carbolic acid, about m.ij. ad f3j. As soon as the probe detects that the bone is loosened, the sinus should be enlarged and the exfoliated portion removed with a pair of forceps.

NECROSIS AND CARIES OF THE ORBIT.—Necrosis of a portion of one of the orbital bones is generally induced by an injury, or by an acute orbital abscess. Caries is usually produced by some constitutional taint, such as syphilis or struma. Both caries and necrosis may follow orbital periorbitis.

Treatment.—For necrosis, time should be given to allow the dead portion of the bone to become detached from the living structures; and then, guided by a probe, passed along the sinus by which the discharge escapes, an incision should be made down to the necrosed bone, which should be removed with a pair of fine sequestrum forceps.

When there is caries, the object of the treatment is to obtain healthy action in the carious bone, and thus produce cicatrization. The remedies must be both constitutional and local. If there be a syphilitic taint, the iodide of potassium, gr. iij. to gr. v., combined with ferri et ammon. citrat. gr. v. in water, may often do good, or the same doses of the iodide combined with gr. x. of the bromide of potassium may be given; or if these fail, other anti-syphilitic remedies may be tried. When caries is due to a strumous diathesis, cod-liver oil, and the syrup of the iodide or hypophosphite of iron will generally do good, especially if the patient can at the same time obtain sea air and a good nutritious diet.

GEORGE LAWSON.

ORBIT, Injuries of the.—**FRACTURE OF THE BONES OF THE ORBIT** may be produced by blows on the head or face, and either the roof, the inner wall, or the floor of the orbit may be fractured.

If the ethmoidal cells have been broken, there is frequently emphysema of the lids and surrounding parts, which is caused by the patient forcibly driving the air through the broken cells when he blows his nose. Fracture of the orbit is frequently associated with fracture of the anterior fossa of the base of the skull, when the presence of blood beneath the conjunctiva is sufficient to indicate that the fracture has extended into the orbit.

There is one form of fracture which is confined to the walls of the orbit, and which is very fatal. It is what may be termed a punctured fracture, and is commonly produced by a forcible thrust in the orbit with a sharp or semi-blunt instrument, such as the points of a pair of scissors, the stem of a long tobacco-pipe, the end of an umbrella, of a stick, or a foil. This accident has also been occasioned by a child falling on a

piece of slate-pencil which it had in its hand. The orbit is penetrated, and the end of the stick, or whatever it may be, is thrust against the roof or the upper part of the inner wall, which in some cases it simply fractures, whilst in others it breaks its way through the bone and penetrates the substance of the brain.

Even when the bones are broken but not penetrated, the sharp splinters usually create such an irritation of the brain and its membranes as to place the life of the patient in great jeopardy. When, however, there is in addition to the fracture a punctured wound of the brain, death is almost certain. It occasionally happens that a portion of the body which has penetrated the orbit and entered the brain has been broken off short, and the fragment which has been left behind has either not been detected during life, or, if discovered, could not be removed. The writer has seen both these conditions occur; in one case a piece of stick which had penetrated the brain through the orbit, and been broken off on a level with the bone, was only discovered at the post-mortem examination; and in a little child whose orbit had been penetrated by a piece of slate-pencil upon which it had fallen, the end of it was broken off flush with the roof of the orbit and could not be seized with forceps and withdrawn, for it broke under the pressure of the blades each time it was caught between them. One curious fact connected with these punctured fractures of the orbit is, that the severe nature of the injury is often overlooked; the external wound may be small, the immediate symptoms may be trifling, and the exact injury is not even surmised. The patient may be able to continue work for some hours, or even two or three days, before urgent symptoms oblige him to desist. Orbital cellulitis and suppuration may then come on, coupled with meningeal or cerebral irritation, and the patient may pass rapidly from slight delirium into complete coma, and die in a period varying from a few days to two or three weeks.

Treatment.—Absolute rest, both mental and bodily, in all cases in which fracture of the orbit is suspected, should be strictly enjoined. The patient should be kept in bed, and cold-water dressing or an ice-bag should be laid over the brow of the injured side; the bowels should be freely acted on by a purgative; and, if pain in the head come on, leeches should be applied to the temple and repeated if they do not give the desired relief. All stimulants should be forbidden, and only a limited diet be

allowed. If the fracture be a penetrating one, the end of the stick, or whatever it may be, should be carefully examined to see if any part of it has been broken off, and the wound should be also examined with the view of ascertaining if there be a foreign body within the orbit. If a foreign body be detected, it should be removed as soon as possible. If orbital cellulitis should come on, a free incision should be made into the cellular tissue of the orbit, so as to give vent to all inflammatory exudations before pus has actually formed. A good opening will frequently give immediate relief to the patient. When there is acute inflammatory action, the cold applications must be stopped, and fomentations of lead lotion—about one drachm of the liquor plumbi subacetatis to half a pint of hot water—be applied on absorbent cotton-wool, and covered with oil-silk; or a warm linseed-meal poultice.

FOREIGN BODIES IN THE ORBIT.—The lodgment of a foreign body in the orbit is a serious accident, as it involves a risk to the eye, and often places the life of the patient in jeopardy. The dangers are both immediate and secondary.

The immediate effects which may arise from a foreign body in the orbit are—(1) In its passage into the orbit it may injure the eye; (2) it may wound the optic nerve and cause blindness, without injuring the globe; (3) it may fracture the wall of the orbit, or it may penetrate the orbital wall.

The secondary effects which a foreign body in the orbit may produce are—

(a) If the foreign body has escaped notice, and been allowed to remain buried in the orbit, it may excite orbital cellulitis and abscess. This may induce a general inflammation of the eye, which may end in impairment of vision, or in destruction of the eye from suppuration.

(b) As the result of the orbital inflammation, a portion of the bones of the orbit may become necrosed; or the inflammation may extend backwards along the orbital periosteum to the membranes of the brain, and destroy life by meningitis, tetanic convulsions, or abscess of the brain.

A foreign body may enter the orbit at any part around the eye, but it generally passes in somewhere between the upper or inner side of the eye and the roof or inner wall of the orbit. If small, it usually buries itself in the loose fat of the orbit, but, if large, it will occasionally become fixed by either penetrating the globe, or by becoming wedged between the globe and

its muscles, or by the end of it entering one of the ethmoidal or frontal sinuses, or by penetrating into the antrum.

It has occasionally happened that a foreign body has been lodged in the orbit and one of the adjacent cavities, without the patient having suffered any great inconvenience from its presence. Mr. Brudenell Carter has related a case in which a large piece of an iron hat-peg was impacted in the orbit and the antrum of the opposite side, and remained there for a number of days without the patient being aware of its presence. It was then extracted, and the man made a rapid recovery without any impairment of the sight of the eye. In February, 1869, the writer extracted from a patient, æt. 28, the iron breech of a muzzle-loading gun, which had been impacted for twelve years in the right frontal sinus and upper part of the nose. The patient recovered without a bad symptom. In 1877 the writer extracted a piece of stick from the orbit of a child æt. 3, which had penetrated the orbit seven weeks previously, and had produced orbital cellulitis and suppuration.

Treatment.—Whenever there is reason to believe that there is a foreign body in the orbit, an attempt should be made to find and remove it. To this rule, however, there are exceptions, as when the foreign body is a small shot, or a fine scale of metal which may have flown off from a rivet or a chisel, and passed into the orbit without injury to the eye. The almost sure impossibility of finding a small fragment of metal in the fat of the orbit forbids the attempt to search for it. The presence of small shot or small pieces of metal rarely produces symptoms of irritation, whilst an extended trial to find them might induce orbital cellulitis with abscess.

Having decided that there is a foreign body in the orbit, the following operation for its removal may be performed:—The outer canthus should be freely divided, either by a pair of scissors or with a scalpel, to allow of the upper lid being completely turned up, or the lower one drawn down, according to the locality in which the foreign body is lodged. The reflection of conjunctiva between the lid and the globe is then to be divided over the spot where the foreign body is suspected to be lying. A probe or the little finger may then be passed through the wound into the orbit by the side of the eye, and the object being felt, it may be seized and drawn out with a pair of sequester-forceps. If the foreign body has become entangled with one of the

recti muscles, or from any other cause one of these should interfere with its easy withdrawal from the orbit, it is better at once to divide the muscle with a pair of scissors as close as possible to the globe, rather than use any force to overcome the resistance it may be causing. The lids are then to be replaced, and closed with a light compress of lint and cotton-wool, and fastened in position with a roller.

INJURIES TO THE OPTIC NERVE. See *OPTIC NERVE, Diseases and Injuries of the.*
GEORGE LAWSON.

ORBIT, Tumours of the.—Tumours of the orbit may be considered under four headings—

I. Tumours which originate within the orbit.

II. Congenital tumours of the orbit.

III. Tumours which have their origin at some site beyond the eye or the orbit, and which by mere growth have extended into the orbital cavity.

IV. Tumours which primarily originate within the eye, and afterwards extend into the orbit; or which recur in the orbit after the eye, the primary seat of the growth, has been excised.

Each of these classes may be considered in detail.

I. TUMOURS WHICH ORIGINATE WITHIN THE ORBIT.—The presence of an orbital tumour is usually indicated by a change in the position of the eye, which is more or less protruded, and generally also displaced in one or other direction, either upwards or downwards, inwards or outwards, according to the locality of the orbit from which the growth springs. All sight may be destroyed by the pressure of the tumour on the optic nerve, or, if there be great protrusion of the eye, by the stretching of the optic nerve. It is, however, often astonishing to what an extent the eye may be projected and the optic nerve stretched without producing great impairment of sight; and how the lost sight is often regained after the eye has been restored to its proper position by the removal of the growth.

To examine an eye which is protruded the patient should be placed in a chair with his head thrown backwards, whilst the surgeon, standing behind him, raises the two upper eyelids with one finger of each hand, and at the same time directs the patient to look downwards towards his feet. From this position, above and behind the patient, the surgeon can glance down the face and contrast the level of the two eyes with each other, and compare the promi-

nence of the protruded eye with the brow and the side of the nose. In this manner a correct estimate may be made of the extent and the direction of the protrusion. When the proptosis is slight, it is often difficult to determine whether the protrusion is real or only apparent, as any oedema of the lids or of the conjunctiva will give a prominent appearance to the eye. Having formed an opinion of the degree of the proptosis, a careful examination should next be made, with the fingers, of the space between the globe and the margin of the orbit, to ascertain if any projecting edge of a tumour can be felt, and if so, to endeavour to obtain some information as to its nature by noting whether it is elastic, hard, or fluctuating.

The tumours which originate within the orbit and external to the eye are:—(a) Orbital sarcomas, growing from the periosteum of the orbit. (b) Tumours of the optic nerve. (c) Scirrhus tumours of the orbit. (d) Bony and cartilaginous tumours of the orbit. (e) Fibrous tumours of the orbit. (f) Cysts of the orbit.

(a) **ORBITAL SARCOMA.**—*Spindle or round-celled sarcoma* usually grows from the periosteum of the orbit, starting first at one point, and then extending itself so as frequently to involve the greater part or the whole of the periosteum. The disease first manifests itself either by some proptosis of the eye, or by diplopia caused by some slight displacement of the globe, or by pressure on the ocular nerves producing palsy of one or more of the ocular muscles, or by pressure on the optic nerve inducing some defect in sight. As the growth advances, the bulging of the eye increases until it is protruded beyond the lids. When the eye by its prominence has lost the protection of the eyelids, the cornea, from exposure, will inflame and ulcerate, and the eye will be destroyed. In some cases, the tumour as it grows will force its way between the globe and the orbit, and it can then be both seen and felt as a hard mass pressing forward beneath either the upper or the lower eyelid, according to the locality in which it has extended itself.

Prognosis.—In all cases of orbital sarcoma the prognosis is unfavourable, as the disease is very apt to recur, and distant internal organs to be invaded by it. If, however, the growth be completely excised at a moderately early stage of the disease, and the chloride of zinc paste be freely applied, a good chance of recovery is afforded the patient. The writer has had several cases of undoubted orbital sarcoma which

he has thus treated, and the patients have lived some years without any recurrence or manifestation of the disease elsewhere.

(b) TUMOURS OF THE OPTIC NERVE are rare. See OPTIC NERVE, Diseases and Injuries of the.

(c) SCIRRHOUS TUMOUR OF THE ORBIT is a rare affection, and it has been doubted whether true scirrhous ever does occur in the orbit. The writer has had two cases of scirrhous of the orbit under his care. The first case was in a woman from whom he removed a scirrhous tumour of the orbit, and at the same time a secondary scirrhous tubercle in the skin in front of the ear and lying over the parotid gland. After excising the tumour he freely applied the chloride of zinc paste, and the whole of the bones of the orbit were detached in one piece, and are to be seen in the museum of the Middlesex Hospital. The operation was performed in February, 1866, and the patient up to the present time, January, 1885, has continued well and free from any recurrence of the disease.

The second case was also in a woman in the Middlesex Hospital. She had a tumour of the orbit which caused great proptosis. The same treatment as in the preceding case was adopted, and portions of the orbital bones exfoliated. The parts healed up, and the patient left the hospital apparently well. A few months afterwards it was found that she had a scirrhous tumour in each breast. It is probable that these tumours existed at the time of the operation on the orbit, and that she had not noticed them. About twelve months afterwards the patient died at her own home with all the symptoms of secondary cancer in the abdominal viscera. There was no return of the disease in the orbit.

Treatment of Sarcomatous, Scirrhous, or Recurrent Tumours of the Orbit.—If the tumour is small and grows from the periosteum near the margin of the orbit, it may be dissected out and the eye, if possible, saved. It is, however, only in exceptional cases that this course can be adopted. As a rule, it is necessary first to enucleate the eye, and then to proceed to excise the tumour, and this is most conveniently done with a pair of small but strong scissors, curved on the flat, and a pair of toothed forceps. Having excised as much of the tumour as can with safety be removed, the actual cautery should be freely applied to those parts of the growth which may still remain, and to all the bleeding points. When all hæmorrhage has ceased, the chloride of zinc paste, the formula for

which is given below, spread on small pieces of lint, should be laid evenly over the whole surface from which the tumour has sprung. A small pledget of cotton-wool should then be placed in the orbit, and over this a fold of dry lint, which is to be held *in situ* by a bandage tied firmly around the head. Before the patient awakes from the anæsthetic, from one-sixth to one-third of a grain of the acetate of morphia should be injected subcutaneously into the arm, to dull the severe pain which usually follows this proceeding.

Where the writer has excised the eye with the orbital tumour and has been able to save the conjunctiva which covered the globe, he has adopted the following method of applying the chloride of zinc paste, in order to avoid the sloughing of the eyelids which so generally happens from the caustic extending to them.

After the eye and tumour have been excised, pressure is to be made in the orbit until all bleeding has ceased. The mouth of the conjunctival bag, from which the eye has been enucleated, is now to be held open with two pairs of forceps, whilst the chloride of zinc paste spread on lint is plastered round the sides of the orbit. A small piece of cotton-wool is next introduced to keep the strips of lint *in situ*, and the mouth of the conjunctival bag is closed over the whole by a single continued suture. A layer of oiled lint is then placed over the conjunctiva, and upon this the lids are closed and kept in position with a compress of lint and a roller. In this way he has destroyed all that was required without affecting the lids.

On the day following the operation the bandage may be removed, and if there is much tension of the lids from the stuffing within the orbit, some of the cotton-wool may be gently drawn out, and, a piece of clean lint having been laid over the parts, another bandage should be lightly applied. The remainder of the cotton wool should be taken away on the second day, and a little fresh absorbent wool laid loosely within the orbit to absorb the discharge, as soon as suppuration commences. This dressing should be repeated daily, but the pieces of lint, on which the chloride of zinc has been applied, should not be removed until suppuration has quite loosened them from the surface against which they were placed. After about ten or twelve days the sloughs will separate from the orbit, and if any suspicious-looking granulations spring up, they should be touched with the solid chloride of zinc or with the potassa cum

calce. The writer has three times seen epileptic convulsions follow within thirty-six hours after the operation, but they have in each instance ceased shortly after the removal of the cotton-wool and chloride of zinc from the orbit. The fits did not recur, and the patients perfectly recovered. If convulsions should occur, the chloride of zinc dressing should be at once removed and the cavity be syringed out with a little dilute acetic acid, about one drachm to the ounce of water.

In removing tumours from the orbit, it should be remembered that the orbital plate of the frontal bone is frequently thin and soft from the pressure of the growth against it. Special care should therefore be taken during the operation to avoid applying force with any instrument against the roof of the orbit. Twice the writer has been present when brain-substance has been brought away with portions of the tumour. On each occasion there is no doubt that, in places, the orbital plate had completely disappeared before the pressure of the tumour, which had grown through it.

The following is the formula for making the chloride of zinc paste:—

Pasta Zinci Chloridi. (Ph. Middlesex Hospital.)

This paste is prepared by first making the *Liquor zinci chloridi cum opio* as follows:—

Zinci chloridi, ʒxvj.; *Pulveris opii*, ʒiss.; *Acidi hydrochlorici*, fʒvj.; *Aquam bullientem ad Oj*.

Macerate the opium in twelve ounces of the boiling water for twelve hours, add the acid and filter, then dissolve the chloride of zinc in the filtered liquid and make up to twenty ounces with distilled water.

To this, flour is added, to render it of a proper consistence, as follows:—

℞ *Liquoris zinci chloridi cum opio* fʒj.
Farinæ tritici gr.cxx.

Mix smoothly in a mortar, and heat over a water-bath until of a proper consistence.

(d) BONY AND CARTILAGINOUS TUMOURS OF THE ORBIT are of two kinds—1. Those which are attached within the orbit by a small bony pedicle. They may be composed entirely of bone, or of both bone and cartilage. These growths may be as large as a walnut, and yet from their slender connection with the orbit they have been easily detached. 2. Those bony tumours which grow within the orbit, but which have a broad base, and occasionally extend through the orbital bones into the cranial cavity. Some of these growths are of an ivory hardness.

Treatment.—In all cases of bony tumour of the orbit an exploratory examination should be made, but with the understanding that the operator has discretionary power to endeavour to remove the growth, or to leave it, as he may deem advisable. Without such an exploratory operation, it is impossible to decide whether the tumour is attached to the bony walls by a thin pedicle or a broad base. The writer has, on several occasions, found that the tumour, although rather large, and apparently fixed to the orbital walls, had only a small pedicle, and was removed without difficulty. On the other hand, he has found the tumour with such a broad base that he decided to leave it, rather than run the risk of fracturing the orbit by an attempt to remove it. On one occasion, with a small chisel he succeeded in splitting off from the inner side of the orbit a small bony tumour, which had a base three-fourths of an inch long and a quarter of an inch wide. The patient did well, and the tumour did not recur.

A very instructive case of a large orbital and intracranial ivory exostosis is reported by Mr. Tweedy in the *Royal London Ophthalmic Hospital Reports*, vol. x. p. 303, in which he succeeded in removing the orbital portion of the growth by a drill worked by a powerful Archimedean screw. He says: 'By means of drills of various sizes, I managed to bore a large number of tunnels in various directions through the base of the growth, parallel with the upper and inner walls of the orbit. I then cut through the narrow bony septa between the borings with a stout carpenter's chisel. When the chisel had made its way deep enough to act as a wedge, I gave a few energetic blows with the mallet, and succeeded in breaking off the whole of the orbital portion of the growth. When this was accomplished, the orbital cavity seemed almost normal in size and shape, though it was obvious that a large mass, forming the base of the growth, still remained behind.'

The patient did well until one month after the operation, when head-symptoms came on, and he rapidly died comatose. On the post-mortem examination it was found that the greater part of the exostosis was in the left anterior cranial fossa. It had originally sprung from the left frontal sinus, and had grown chiefly upward.

In all operations for orbital tumours the surgeon should be provided with small bone-forceps, a bone-chisel, a gouge, an elevator, and a small Archimedean drill.

(e) **FIBROUS TUMOURS OF THE ORBIT** are not common, still they do occur and it is of importance to recognise them, as the prognosis is much more favourable than in the sarcomatous growths which form the majority of the orbital tumours. The fibroid tumour grows from the periosteum of the orbit, to which it is frequently attached by a pedicle of less dimensions than the mass of the tumour; in some cases the pedicle is very small. When completely removed with the pedicle and the portion of the periosteum from which it springs, the probability is that the tumour will not return; but this entire removal of the growth is often difficult, and sometimes impossible to be accomplished from the attachment to the periosteum being far back in the orbit. In some cases, therefore, the growth recurs, and probably from a small portion of it having been left behind at the time of the operation.

There is, however, another form of fibroid tumour which may occur in the orbit, and which is recurrent, but not necessarily in the site from which it first grew. It may reappear in other localities, generally selecting for itself some fibrous expansion from which to sprout. The writer has met with only one case of this kind; it is reported in full in the *Royal London Ophthalmic Hospital Reports*, vol. vi.

Symptoms and Treatment.—In the cases which the writer has seen there has been some proptosis of the eye, and the tumour has made its way forward between the globe and the orbit, and bulged into the lid. The diagnosis of the nature of the tumour cannot be made before the operation, although a certain amount of mobility under the fingers suggests that the growth may be fibroid.

In such cases the tumour may frequently be removed without excising the eye. An incision should be made through the lid near the margin of the orbit, so as to expose freely the surface of the tumour, and then with a little care the tumour may be isolated and traced backwards to the part from which it springs, and be detached with a portion of periosteum, if near the anterior surface of the orbit; or if it springs from deep in the orbit, its pedicle may be divided with a pair of scissors. The wound of the lid may be then united with one or more fine sutures.

(f) **CYSTS OF THE ORBIT** are far less frequent than the solid orbital tumours. They are of various kinds—(1) Serous cysts; (2) hydatid cysts; (3) dermoid cysts.

(1) **SEROUS CYSTS** within the orbit are so rare that it is probable that some of the cases which have been described as serous cysts have really been hydatid. A very interesting case of serous cyst in the orbit was recorded in the *Royal London Ophthalmic Hospital Reports*, vol. i., by the late Mr. Poland.

(2) **HYDATID CYSTS OF THE ORBIT** are comparatively rare, yet many cases have been recorded. Lawrence, in his *Diseases of the Eye*, relates the case of a man, æt. 42, who was under his care in the London Ophthalmic Hospital in 1820, with protrusion of the globe. By an incision into the orbit he removed half a teacupful of hydatids. In the *Royal London Ophthalmic Hospital Reports*, vol. iv. Mr. Hulke has also recorded a case of hydatid cyst in the orbit.

The writer has had two cases of hydatid cyst in the orbit. The first case, recorded in the *Clinical Society's Trans.*, vol. ix., was remarkable from the 'choked optic disc,' which was produced by the pressure of the hydatid cyst on the optic nerve in the orbit, and the fact that the great engorgement of the optic disc disappeared after the cyst was evacuated by puncture. The second case is recorded in the *Royal London Ophthalmic Hospital Reports*, vol. x.

Symptoms.—Proptosis of the eye, and a tumour which can be felt with the fingers projecting between the edge of the orbit and the globe, more or less rounded in outline, with a smooth surface, and imparting to the fingers a sense of fluctuation; impairment of sight, rapid growth of the tumour with pain, which is frequently recurrent in its early formation, and no inflammatory action.

The shape and feeling of the tumour would indicate that it was a cyst, whilst the rapidity of growth, the pain in its early stages, with the absence of inflammatory action, would suggest that the tumour might be an hydatid. No positive diagnosis can be formed without an exploratory puncture either with a fine knife or a trocar. It occasionally happens that an hydatid tumour will remain stationary for some years and then take on rapid action, but this is not the usual course. These tumours generally develop steadily, and with increased growth there is an increased protrusion of the eye.

Occasionally, an hydatid tumour will inflame and suppurate spontaneously, and then all the symptoms point to orbital abscess.

For treatment see below, *Treatment of Cysts of the Orbit*.

(3) DERMOID CYSTS OF THE ORBIT are extremely rare. A very remarkable case of the kind was recorded by Mr. S. Barnes, surgeon to the Devon and Exeter Hospital in the *Médico-Chirurgical Transactions*, vol. iv. p. 316.

The usual situations for dermoid cysts adjoining the orbit are—at the upper and outer margin, and at the lower and inner edge of the orbit, just over the nasal process of the superior maxillary bone. They are congenital, and although to the touch they appear superficial, they are really deeply placed, lying in a depression of the bone beneath the orbicularis and often very adherent to the surrounding parts. They are filled with sebaceous material, and contain numerous hairs. These cysts, when large, will sometimes extend deeply into the orbit, and their removal then is frequently attended with considerable difficulty.

Treatment of Cysts of the Orbit.—In all cases, if practicable, the cysts should be removed entire. A free incision should be made over the most prominent portion down to the cyst wall, when it can often be enucleated; or, if not, it may be carefully dissected away from its surrounding attachments. When, from the position of the cyst in the orbit and the prolongations of it between the orbital muscles, it is found impossible to get it completely away, the cyst should be freely opened, and either an india-rubber drainage-tube or a piece of lint dipped in carbolic oil should be inserted into its cavity, to keep the cut edges from uniting and to allow of the free escape of all inflammatory products. The cavity should be washed out daily with a weak solution of carbolic acid.

In hydatids of the orbit, a free incision should be made into the tumour, and, after the fluid has escaped, the finger should be introduced into the cavity, and if possible the whole cyst be turned out; but, failing to accomplish this, the wound should be kept open by a large drainage-tube, and the cavity washed out daily with a solution of carbolic acid, about 1 in 80 parts of water.

II. CONGENITAL TUMOURS OF THE ORBIT are developmental growths. They originate during embryonic life *in utero*, and continue to grow after birth.

The following is an abstract of the report of the only case of this kind which has come under the writer's care. In May, 1882, he excised the eye of a child only two days old, on account of a congenital tumour of

the orbit, which had completely extruded the eye from between the lids. The little patient was taken to the Royal London Ophthalmic Hospital, suffering from complete exophthalmos, which was congenital, and evidently due to an orbital tumour. The eye was removed, and for a time the patient did well. The child lived into the middle of the August following, and was in fairly good health until within two days of its death, when convulsions came on, which were followed by coma. The post-mortem and microscopical examinations were made by Mr. Milles, then curator of the museum. The following is an abstract of his report:—A large tumour was found projecting from and filling up the right orbit. On opening the skull, the upper surface of the brain and its membranes were quite healthy. On the under surface there was a distinct impression in the right middle lobe, produced by the projection of several cysts from the sphenoid bone. There was well-marked basic meningitis, confined chiefly to the right side. The tumour seemed to have originated in the body of the sphenoid bone, and to have grown forwards, filling up the cavity of the orbit, and pushing the eye in front of it. The tumour was pretty solid, but contained numerous cysts in its substance. Under the microscope, the tumour was found to consist of several varieties of tissue in different stages of development. The most noticeable were patches of hyaline cartilage of a spherical or oblong shape; these were often surrounded by a zone of spindle cells, with a distinct gradation from cartilage cells. Numerous cysts of all sizes were scattered through the tumour. The walls of the cysts were usually lined by pavement epithelium. In places, small cysts were seen to be projecting from the walls of the larger ones. The more solid part of the tumour consisted of masses of round cells like embryonic tissue, spindle cells, and more fully developed fibrous tissue. There was evidence of formation of glandular structure at several parts. The microscopical examination showed that the tumour was evidently one of embryonic origin, with an attempt to develop into the lower forms of connective tissue and gland-structure.

Mr. T. Holmes has recorded in the *Pathological Transactions*, vol. xiv. p. 248, the successful removal of a congenital tumour of the orbit, from a child æt. seven weeks. On examination, the tumour was found to consist of 'a large mass of substance much resembling udder, of a hard uniform feel and white colour—not in any

respect resembling malignant disease.' Numerous cysts, containing thin serum, had been laid open. Other smaller solid masses lay in the neighbourhood of the principal tumour. Under the microscope the solid portion of the tumour showed nothing except fibrous tissue and simple nuclei.

III. TUMOURS WHICH HAVE THEIR ORIGIN AT SOME SITE BEYOND THE EYE OR THE ORBIT, AND WHICH BY MERE GROWTH HAVE EXTENDED INTO THE ORBITAL CAVITY.—These growths include tumours which spring from the antrum, the frontal sinus, the lacrymal canal, or from some portion of the bones which help to form the base of the skull, as the naso-pharyngeal polypi. They will be found described under their respective headings.

The other tumours of the orbit are distension of the frontal sinus from pent-up secretion and pus (*see* FRONTAL SINUS, Diseases of the); pulsating exophthalmos, or so-called ORBITAL ANEURISM; venous nævi of the orbit (*see* NÆVUS).

IV. TUMOURS WHICH ORIGINATE WITHIN THE EYE, AND AFTERWARDS EXTEND INTO THE ORBIT; OR WHICH RECUR IN THE ORBIT AFTER THE EYE, THE PRIMARY SEAT OF THE GROWTH, HAS BEEN REMOVED:—(a) Sarcoma and melanotic sarcoma of the choroid; (b) glioma of the retina.

(a) SARCOMA AND MELANOTIC SARCOMA OF THE CHOROID are essentially the same, the only difference being the addition to the latter of pigment, which is scattered in varying quantities between the sarcomatous cells. The identity of sarcoma and melanotic sarcoma is illustrated by the changes which sometimes occur in the growth of the tumour. Whilst confined within the globe, the sarcoma may be deeply coloured with pigment, but, having burst through the sclerotic, the tumour may grow with increased rapidity, and the extra-ocular portion remain white. Although a large number of the sarcomas which spring from the choroid are pigmented, yet the writer has excised many eyes in which the growth was white.

The early symptoms of sarcoma of the choroid are usually not noticed by the patient, unless the growth originate near the yellow spot of the retina, when an impairment of sight first draws attention to the eye. This is often discovered suddenly from the sound eye being accidentally closed, when it is noticed that a portion of the field of vision is more or less defective. This impairment of the field is due to a commencing detachment of the retina from the pressure of the growth behind it. With

the advance of the tumour the field of vision becomes more contracted, the area of the blind portion increases, the acuteness of vision of the rest of the retina diminishes, until ultimately the eye becomes blind. During the early development of the symptoms there is no pain; it is only when the growth has attained a sufficient size to exercise pressure on the lens, ciliary body, and iris that pain is produced. When once started, the pain increases with the growth, and becomes excessive when the globe is distended by it.

It is seldom that the patient seeks advice until there is some detachment of the retina from the pressure of the growth behind it. That the case is not one of simple detachment of the retina may be sometimes determined at once by the ophthalmoscope, when the vessels of the detached retina may be clearly recognised, whilst behind the semi-transparent retina a series of vessels which are not retinal, but which belong to the new growth, may be made out. In the *Royal London Ophthalmic Hospital Reports*, vol. iv., is recorded a case in which Sir W. Bowman was able to distinguish the vessels on the surface of the tumour from the vessels of the detached retina in front of it. It is, however, only in an advanced stage of the disease that this means of diagnosis can be available. The most important point in diagnosing a detachment of the retina caused by a tumour of the choroid is the state of the tension of the eye. As the disease advances there is generally an increase in the tension of the eye, and this glaucomatous state is associated with pain, which may vary from a slight sense of aching to an acute neuralgia in the eye, and extending over the brow and forehead. An eye with failing sight, a partial detachment of the retina and an increased tension, is very suggestive of an intraocular tumour, even though the growth itself cannot be seen with the ophthalmoscope.

It is often impossible to diagnose the glaucomatous condition which is induced by an intraocular tumour from an ordinary attack of glaucoma, as the accession of pain is frequently sudden, and, when seen by the surgeon, the media may be so dull that the fundus of the eye cannot be seen; and the distended episcleral vessels and more or less dilated pupil, with increased tension of the globe, present all the appearances of a case of subacute glaucoma.

Such cases have frequently been treated by iridectomy, and the true cause of the tension has been only discovered when

the eye has been afterwards excised from the iridectomy having failed to give any relief.

As the tumour grows, it gradually fills the globe and displaces the structures within the eye which are in front of it. The retina is extensively or completely detached, and the lens is pressed against the iris, and the iris bulged towards the cornea. Frequently the globe loses its normal shape, and dark bulgings are seen in the ciliary region. The tumour next makes an exit for itself. Either the cornea grows dull, then ulcerates, and through the opening the tumour protrudes; or else it forces its way through the sclerotic, either in the ciliary region or in a more posterior part of the eye. Having escaped from within the globe, the tumour seems to grow with an increased vigour; if it has burst through the globe anteriorly, its surface after a time ulcerates and bleeds, and assumes an appearance which has given to it the name of 'fungus hæmatodes.'

The attacks of hæmorrhage increase in frequency with the advance of the disease, until at last the patient sinks, worn out with pain and loss of blood. If the tumour has escaped through the sclerotic posteriorly, it grows rapidly in the cellular tissue of the orbit, and protrudes the eye; and this protrusion is sometimes to such an extent that the cornea will ulcerate and suppurate, from the exposure caused by the lids being unable to close over the eye.

Prognosis of Sarcoma of the Eye.—The prognosis depends very much on the period of the disease at which the eye is removed. If the disease be detected early and the eye be at once excised, there is a reasonable hope that there will be no recurrence in the orbit, and that years may elapse before there is a recurrence in any of the internal organs; indeed, that the patient may live many years and die of some other disease before any secondary deposits have taken place in the liver, lungs, or other organs. When the eye has been removed at an early period of the growth, the operation often seems to create a pause in the progress of the disease, which may extend over a variable length of time—certainly in some cases over ten years. Patients may die from secondary sarcomatous deposits in the liver and other organs ten and twelve years after the eye has been excised for an intraocular tumour, and without any recurrence in the orbit.

Dr. Knapp, in an excellent treatise on intraocular tumours, mentions several cases of a prolonged freedom from recurrence of

the disease after the eye had been excised. 'Prof. Dor's patient, fifty-six years of age, had in the year 1858 first noticed a blank portion in the field of vision of his right eye. The enucleation was made in January, 1860, whilst in a state of glaucomatous inflammation. The eyeball was slightly enlarged in its dimensions; the tumour, a melanotic, tough, fusiform-celled sarcoma of the choroid. . . . Nine years after the operation the patient was perfectly well.' Further on Dr. Knapp says:—'Professor Weber reported in the *Med. Naturhistorische Verein*, in Heidelberg, that both of the cases of choroidal melanosis were still perfectly well—one thirteen, the other twenty years after the operation. Mr. Hulke excised the eye of a gentleman in April, 1862, for a white spindle-cell sarcoma of the choroid, and the patient nine years afterwards was in perfect health.' These cases, no doubt, are rather exceptional, but still they sustain the hope that, if the eye be excised at an early stage of the disease, no recurrence may take place, or certainly that the patient may enjoy an immunity for many years.

When recurrence of the sarcoma occurs internally, there is scarcely an organ in the body which may not be involved by the secondary deposits. The liver, the lungs, the kidneys, the lumbar glands, the heart, and the brain may all become the seat of sarcomatous deposits.

In the museum of the Middlesex Hospital there is a series of preparations of secondary melanotic deposits in the different internal organs, which were taken from the body of an elderly female patient who had had a primary melanotic sarcoma of the choroid of the left eye. The right ventricle of the heart contained a mass of the secondary black sarcomatous deposit, which occupied the whole thickness of the wall and projected into the ventricular cavity. Both lungs and pleuræ were studded with the same black deposit; the seventh rib was the seat of a similar deposit. The liver and kidneys were affected, like the lungs, with large black deposits, and the spleen was the only internal organ that appeared healthy. In the sheath of the rectus there was a melanotic mass, the size of a pigeon's egg, which seemed to have no attachment. Throughout the body many of the glands were infiltrated with pigment, and were thus visible through the skin, though only slightly enlarged.

Treatment.—Excise the eye as soon as possible after the tumour of the choroid has been detected; even though the tumour be

no larger than a pea, and the sight of a portion of the retina good, yet there should be no delay. The earlier the eye is removed, the better for the patient. If the tumour has burst through the coats of the eye and has extended into the orbit, the chloride of zinc paste should be applied as recommended under *Treatment of orbital sarcoma*. The mode of application of the chloride of zinc must depend on the extent of the tumour in the orbit and the degree of apparent infiltration of the tissues with it. When the tumour has only just burst through the globe, and can be removed in its entirety, a thin layer of the paste spread on thin linen or cambric will probably be sufficient; but when the extension of the tumour into the orbit has been large, the chloride of zinc paste must be applied freely.

(b). GLIOMA OF THE RETINA is a disease of early life, and, in the writer's experience, is limited to early childhood. The writer has seen cases in which it was congenital, and he has not met with a case of retinal glioma which originated in a child beyond the age of five years. In appearance a glioma very closely resembles brain-substance; it is soft, of a white or yellowish white colour, and springs from the connective-tissue (the neuroglia) of the retina.

In structure it consists of a finely granular or amorphous intercellular substance, in which are embedded spherical, roundly oval, and occasionally spindle-shaped cells. It is usually of rather slow growth, extending over a period of from one to two years before it completely distends the globe and bursts through the sclerotic or cornea. As it grows, portions of it undergo fatty degeneration and become so soft as to be almost fluid, whilst other parts become chalky or calcareous. The disease spreads by infection, which travels along the optic nerve, and after death a similar growth is frequently found in the brain in direct communication with the optic tracts. In a child who had been under the writer's care, and had died from a recurrent glioma, a tumour was found within the skull, which had extended backwards from the mass within the orbit, and pressed upon, but was not connected with, the brain. The preparation is in the Middlesex Hospital Museum, and the case is reported in the *Transactions of the Pathological Society*, 1884-5. Glioma seldom produces secondary deposits in the abdominal or thoracic viscera; but Knapp has recorded one case in which there were secondary gliomas in the liver, lungs, and diploë of the bones of

the cranium. (Knapp *On Intra-Ocular Tumours*.)

Glioma is very recurrent, and is very apt to appear in the other eye after the eye in which it started has been removed, and also to recur in the orbit. There are exceptions to the recurrence of glioma after the diseased eye has been removed. In 1872 the writer excised the right eye of a child, æt. two years and eight months, on account of a glioma of the retina, and after more than seven years there was no return of the disease.

Symptoms.—Dilatation of the pupil with diminution of sight. In the early stage of glioma there is no pain. The disease is usually first discovered by the nurse or the mother noticing a bright yellow reflex from the fundus of the globe, and then, on closing the sound eye, it is found that the affected one is almost, if not completely, blind. The refracting media are generally so clear that the tumours can be easily seen. As the disease advances there is increased tension of the globe, and then the eye becomes painful and the child restless, frequently crying and starting in its sleep. The lens and the iris are pushed towards the cornea, and the pupil becomes dilated and inactive. At a later stage of the disease the lens becomes cloudy and the cornea dull, and the tumour bursts its way through the globe and forms a fungating mass, from which there are frequent recurrences of hæmorrhage; and the child dies, either worn out by pain and exhaustion, or from meningitis caused by an extension of the disease within the skull. If the eye be examined with the ophthalmoscope when the disease is in a comparatively early stage, the glioma will be seen occupying a limited portion of the retina, and with blood-vessels on its surface which clearly belong to the new growth. In the immediate locality of the tumour the retina is detached, and this detachment increases with the advance of the disease.

Treatment of Glioma.—Excise the eye as soon as the disease is discovered, and, should the two eyes be affected, both should be excised, provided the sight has been already destroyed. The removal of the two eyes in such a case would afford the only chance of recovery, whilst at the same time it would save the child much ultimate suffering. The writer has on many occasions removed the second eye for the sole purpose of procuring some temporary relief from the excessive pain induced by the over-distended globe, and when there has not been the slightest prospect of arresting the

disease. In each case the operation gave immediate and perfect relief. Even if the disease should recur rapidly in the orbit, the child is greatly benefited by having had the eye removed, as the growth of the tumour in the orbit is comparatively painless when the resistance caused by the eye has been taken away. GEORGE LAWSON.

ORBITAL ANEURISM.—*Symptoms.*

If the term 'orbital aneurism' were strictly interpreted so as to embrace instances of circumscribed and diffused aneurisms, arterio-venous communications, and aneurism by anastomosis affecting vessels only within the limits of the orbital cavity, the space necessary for their description would be very small. There are on record very few genuine cases of aneurisms of vessels within the orbit. But in the immediate neighbourhood of the orbit there are large blood-vessels, whose morbid conditions affect the circulation within the orbit and the eye, and give rise to aneurismal symptoms that find here a characteristic outward and visible expression, by which they become cognisable to the clinical observer, and arouse the serious solicitude of the patient.

Aneurismal affections and morbid conditions of blood-vessels within the orbit, within the cranial cavity immediately behind the orbit, and possibly in the pterygoid and sphenomaxillary fossæ, give rise to symptoms essentially similar. The common features, variously combined and modified in different cases, are protrusion of the globe or exophthalmos; pulsation of the protruding globe, palpable to the touch and often visible to the eye; a soft pulsating tumour at some point of the orbital margin, usually above the eye, beneath the inner part of the orbital arch, but occasionally at the outer side, sometimes below the eye at the lower and inner angle; bruit and noises in the head; distended veins on the conjunctiva and on the lids and forehead; chemosis; obliteration of the hollow beneath the orbital arch; pain; paralysis of orbital muscles and iris; and cessation or lessening of the bruit and noises in the head, recession of the globe, and diminution of the swelling and abolition of pulsation by pressure on the corresponding carotid artery. The most characteristic symptoms are the presence of a pulsating tumour at the orbital margin and pulsation of the protruding eyeball. Hence, the terms 'pulsating tumour of the orbit,' 'pulsating exophthalmos,' and 'vascular protrusion of the eyeball,' are sometimes employed to describe cases in which these phenomena

are conspicuous. The advantage of these terms is that they do not express any theory of causation; the disadvantage is that they are not individually and universally applicable to all cases in which the diagnosis of aneurism may fairly be made. Pulsation of the eyeball, vascular protrusion of the globe, and a pulsating tumour may each in their turn be absent, without contra-indicating the diagnosis of 'orbital' or 'intra-orbital aneurism,' a phrase in itself open to objection for the expression of a group of aneurismal symptoms, whose cause lies far more frequently behind the orbit than in it.

It will be as well to premise that cases of orbital aneurism sometimes arise spontaneously, and sometimes are the direct result of injury—in other words, are divisible into two groups, the idiopathic and traumatic.

Pathology.—There have been at least fourteen post-mortem examinations of cases of so-called orbital aneurism, with the following results:—

1. In one bilateral case (Guthrie's), an aneurism of the ophthalmic artery was found in each orbit.

2. In three idiopathic cases (Baron, Gendrin, Nunneley), there was a ruptured aneurism in the cavernous sinus.

3. In four traumatic cases (Nélaton (2), Herschfeld, Schlaefke), there were arterio-venous communications between the carotid and the cavernous sinus.

4. In four cases—one traumatic, three idiopathic (Bowman and Hulke, Aubry, Ettingen, Morton), there were blocked orbital veins and cranial sinuses.

5. In one idiopathic case (Nunneley), there was an old aneurism of the ophthalmic artery within the cavernous sinus.

6. In one idiopathic case (Wecker and Richet), there were dilatation and atheroma of the carotid.

The two latter observations are not satisfactory, and the first leaves much to be desired. The fourth or venous group is important, and may be said to require support by future observers, who will work with the knowledge that arterio-venous communications are frequent causes of the symptoms of orbital aneurism, but may be readily overlooked at post-mortem examinations superficially conducted, and so completely explain the aneurismal symptoms both in idiopathic and traumatic cases; and that thorough examination of both carotids and both internal maxillaries should be made if all scepticism as to the absence of arterial lesion is to be placed out of court.

Post-mortem examinations have further proved that—

(a) Thrombosis of the cavernous sinus and ophthalmic vein may be present without occasioning the essential symptoms of intra-orbital aneurism. Exophthalmos, cedema of the orbit, hyperæmia, photophobia, dilated immovable pupil, paralysis of the muscles of the eye, and diminution of vision are the evidences of this condition.

(b) Aneurism of the internal carotid in the cavernous sinus may be present without giving rise to the essential symptoms of intra-orbital aneurism. The same remark will probably be found applicable to aneurisms of the ophthalmic artery at its origin from the internal carotid. The orbital symptoms, noted in cases of aneurism of the internal carotid in the cavernous sinus, have been sometimes only symptoms due to pressure on the nerves, especially the third, fourth, and fifth, such as ptosis, dilated and fixed pupils, impaired or uncertain movements of the eyeball, diplopia, defective sight; and sometimes superadded to these, symptoms due to obstruction to the return of venous blood, cedema of the lids and conjunctiva, hazy and ulcerated cornea, and injection of the sclerotic and conjunctiva. The other symptoms have been violent pains in the head and at the back of the orbit, continual headache or heaviness of the head, unrelieved by treatment, and singing or other noises in the head.

(c) The cavernous sinus may be obliterated without giving rise to the essential symptoms of intra-orbital aneurism.

With regard to the nature of the reported cases—more than 100 in number—the following statements may be made:—

1. Beyond question, the great majority of the traumatic cases have been instances of endocranial arterio-venous communications, due to wound or rupture of the internal carotid artery in the cavernous sinus.

2. Beyond question, the great majority of the idiopathic cases have been instances of endocranial arterio-venous communications, due to rupture of an aneurism of the carotid or of an atheromatous carotid, in the cavernous sinus.

3. The occurrence of a circumscribed aneurism of the ophthalmic artery, or one of its branches, as a cause of the same symptoms as were exhibited in the cases of arterio-venous communication, rests, at present, solely on the laconic report of Guthrie, who gave no account of the condition of the cavernous sinuses and internal carotid arteries. Moreover, aneurism of the ophthalmic artery in the orbit is a very rare

affection. Small aneurisms are occasionally found, with the ophthalmoscope, on the branches of the arteria centralis retinæ.

4. Diffused aneurisms of the ophthalmic artery have not been shown to have given rise to the symptoms of 'orbital aneurism.' In 1859 M. Demarquay divided the cases of intra-orbital aneurism into two categories—the traumatic and the idiopathic. The traumatic he regarded as dependent upon a rupture of the ophthalmic artery, followed by an effusion of blood and the formation of a diffuse aneurism, which he called a 'primitive diffuse aneurism'; whilst in the idiopathic cases he supposed that there existed, first of all, a circumscribed aneurism of the ophthalmic artery, which was suddenly ruptured and became diffuse at the time of the commencement of the symptoms, and this form of aneurism he called 'consecutive diffuse aneurism.' M. Demarquay's views were adopted by some authorities, but they have not yet been shown to be even partially true. In no one case have the symptoms of intra-orbital aneurism been proved to be due to a tearing across of the ophthalmic artery, at or near the optic foramen.

A few cases of pulsating sarcoma have crept into the lists of cases. Freer's case was one of fungus hæmatodes. Critchett's was a pulsating sarcoma, and so in all probability was Szokalski's case. Van Buren's sarcoma case is included in some lists.

The *Differential Diagnosis* of the various morbid conditions of blood-vessels within and behind the orbit, and of the affections which may be mistaken for them, will best be established by a summary of the distinctive features of each.

1. *Traumatic arterio-venous communications between the Carotid Artery and Cavernous Sinus* will be preceded by the history of an efficient lesion, such as a bullet wound or shot wound, a punctured wound, or a blow or fall sufficient to occasion a fracture of the base of the skull. Occasionally, the communication will be on the side opposite to the seat of injury in the orbit; usually, the two will correspond. At first, the aneurismal symptoms may be masked by the general symptoms of injury to the head. As a general rule, they are fully developed within nine months of the accident preceding the affection. More than half the cases exhibited all the symptoms within two months. Some of the cases were not seen till a much later period, but, from the history, it is clear that all the symptoms were well established a few weeks after the

injury. In one or two cases only was there an interval of years. The primary symptoms present some variations. In some, a blowing, roaring, or singing noise, or beating in the head, is stated to have been heard either immediately or soon after the injury. In a few, congestion of the conjunctiva and chemosis, with or without loss of power in the ocular muscles and inaction of the pupil, preceded exophthalmos, pulsation, and bruit; so that in two or three cases the patients seemed to be affected with simple conjunctivitis. Exophthalmos is said to have preceded the pulsation and bruit in about half the cases, and was noticed within the first six weeks in a similar proportion.

Doubtless, the interval between the infliction of the injury and the occurrence of the typical symptoms is due to blocking up of the aperture in the artery by coagulum, or pressure on the cavernous sinus and ophthalmic vein by coagulum, which subsequently undergoes absorption or disintegration. Hence, in the early stage, the only symptoms may be some swelling and redness of the conjunctiva, with slight proptosis, due to obstruction of the venous current; but, as soon as the aperture of communication has become clear, noises in the head, bruit, and pulsation in the eyeball will declare themselves. In some cases, a partial rupture may occur and become complete after a variable interval, or weakening of the coats by injury may lay the foundation for ordinary aneurism. As soon as the arterial blood finds its way freely into the cavernous sinus, it will be propelled into the ophthalmic vein, or veins superior and inferior and their tributaries, giving rise to pulsation of the eyeball and the development of a pulsating tumour or tumours at the margin of the orbit, soft, lobulated, compressible and repressible, obliterating the hollow beneath the arch. Pulsation of the eyeball may disappear when the pulsating tumour has developed itself. Congestion of conjunctiva and chemosis will tend to increase. A large pad of infiltrated mucous membrane will project between the lids.

The pulsating tumour will require time for its development, and before the dilated ophthalmic vein or veins become evident at the margin of the orbit, the pulsation may be communicated to the eyeball, so that pulsating exophthalmos will take precedence of the appearance of a pulsating tumour or tumours. In process of time, a tumour will commonly appear at

the inner third of the orbital margin, and the distension of the veins may gradually extend to the tributaries of the main trunk, thus reaching the forehead, the bridge of the nose, and the inner angle of the opposite orbit as well as the lower eyelid. The constant pulsations of the ophthalmic vein may wear a furrow in the bone. With the ophthalmoscope, prominence of the disc, hæmorrhagic spots, and dilated and pulsating retinal veins will be observable. A vibratory thrill in the pulsating veins is a frequent but not constant phenomenon. The bruit is often peculiar and distinctive. It is a continuous bruit, with *redoublement* or reinforcements during the arterial pulse; and, added to this, is a high, plaintive, whistling note, caused probably by the rushing of the arterial blood through a small hole in the carotid, designated by French authors the *bruit de piaulement* or *miaulement*, from its likeness to the mewings of a cat, and audible, perhaps, only in front of the eye over the course of the dilated ophthalmic vein. If the pulsating tumour or tumours are tapped or punctured, arterial blood will issue.

Nerve-lesions may be due either to the same injury by which the artery was wounded or to pressure on the nerves by effused blood and blood-clot. The optic nerve may be torn in a fracture of the base, or the sixth nerve divided by the foreign body which causes a wound of the carotid. Impairment of vision, at a later period, may result from alteration in the circulation or loss of transparency of the media. Ptosis, dilated pupil, and external strabismus from pressure on the third nerve, are not uncommon.

In some cases, the opposite orbit and eye become affected by the passage of arterial blood, from the cavernous sinus on one side through the circular sinus into the opposite cavernous sinus and ophthalmic vein. The arterial blood may also find its way through the emissary veins into the pterygoid plexus, and so, the writer believes, into the temporal veins and into veins on the floor of the orbit, which pass through the spheno-maxillary fissure. When one channel is blocked up another is opened. This explains the recurrence of the disease, in some cases, on the side opposite the seat of injury after subsidence or cure by ligation on one side, and the recurrence on the outer side of the orbit after cure on the inner. A long-neglected case of aneurismal varix may attain a wide development.

2. *Idiopathic arterio-venous communications between the Internal Carotid and*

Cavernous Sinus occur usually quite suddenly, from the rupture of an aneurism of the internal carotid or rupture of a diseased internal carotid, as it lies in the cavernous sinus. In the majority of cases, the disease commenced with pain or noise in the head, or some peculiar feeling on the affected side; in a few gradually, with or without attacks of premonitory pain. Five cases occurred during pregnancy in women who had borne several children. In all the attack occurred quite suddenly, with violent pain and noise in the head variously compared to a 'sudden snap,' the 'cracking of a whip,' 'the report of a pistol overhead,' 'a blowing noise,' and 'a steam hammer;' whilst in six other females not pregnant (three being over sixty years of age), in whom the attack was equally sudden, the several sensations experienced were described as 'something appearing to give way,' with or without a crack like that of a gun, 'a kind of crowding feeling,' 'a strong buzzing,' 'a violent pain in the eye or temple,' and 'something queer in the head.' Two of these patients were aroused from sleep by the pain and noise, in two the affection began as they were getting up as usual in the morning, and the others as they were pursuing some ordinary occupation, such as washing, taking off shoes, rubbing in a liniment, returning from a drive, and sitting down to work. One woman, during an effort of childbirth, felt an 'unusual rattling in the eye,' and perceived that the eye was driven from the orbit; whilst another attributed the affection to an effort made during her last confinement, five years previously. One man felt a deep-seated pain in the eye and singing in the ear, as he was aroused from sleep. Another perceived one morning, after a fit of coughing and without any premonitory symptoms, that the eye was projecting from the orbit.

After the pain and noises, the next symptoms to appear are generally exophthalmos and swelling of the lids and conjunctiva. In extreme cases, the eye may be almost extruded from the orbit. Paralysis of orbital muscles, pulsation of the eyeball, the development of pulsating tumours out of the ophthalmic vein and its branches at the orbital margin, with thrill and the characteristic bruit, dimness and sometimes loss of sight, dilated and fixed pupil, eversion of the lower lid and increase of the conjunctival pad (forming a bright-red tumour projecting between the distended eyelids), pain, often constant and acute, at the bottom of the orbit, and noises

in the head, will soon be superadded to the earlier symptoms. Arterial blood would issue if the pulsating tumours were punctured. As in the traumatic series, the affection may spread to the opposite eye, or commence in the opposite eye after cessation or cure on the same side by ligature of the carotid.

3. *Circumscribed aneurism of the Ophthalmic Artery* would probably, as in Guthrie's case; cause pulsating exophthalmos without a pulsating tumour appearing at the orbital margin, and the bruit might be distinctly intermittent.

4. *Traumatic rupture of the Ophthalmic Artery* in the orbit would, in all probability, be accompanied by tearing across of the optic nerve, and be followed by protrusion of the eyeball and immediate and irreparable loss of vision. There are no facts to guide us in regard to rupture of a true aneurism of the ophthalmic artery in the orbit.

5. The distinctive features of *Aneurismal Varix* within the orbit remain to be determined. A single case of varicose aneurism of vessels within the orbit has been reported.

6. *Obstructed Cranial Sinuses and Orbital Veins* have not yielded symptoms sufficiently distinctive from aneurismal varix of the ophthalmic vein, due to wound or rupture of the internal carotid, to be distinguished. There is one probable means of diagnosis—viz. puncture of the pulsating and dilated ophthalmic vein. In aneurismal varix, arterial blood would issue; in blocked sinuses, &c., venous blood might be expected to appear. Puncture, however, does not exercise a beneficial influence on the part.

7. *Vascular Tumours of the Orbit* are of various kinds, all shading into each other. There are erectile tumours, consisting either of capillary vessels or of a cellular, reticulated, and spongy tissue, containing either arterial or venous blood, and often surrounded by a capsule of condensed connective tissue. These cavernous tumours have neither pulsation nor bruit. Yet they dovetail into the cases of pulsatile arterial nævus, in which a soufflé existed with doubtful pulsation. There appear to be cases also of pulsatile venous nævus. Then, there are venous or varicose tumours formed of dilatations of the ophthalmic vein or its branches, owing to some obstruction to the return of venous blood. If formed by the ophthalmic vein, they will be prominent at the upper and inner part of the orbit, and yield similar sensations to those afforded by the pulsating tumours found in cases

of intra-orbital aneurism, in so far as this, that they will be peculiarly compressible and repressible, but will have neither bruit, pulsation, nor thrill. They will increase in size in expiration and stooping, and diminish in inspiration and the erect posture. Pressure on the internal jugular vein should cause them to swell. These tumours may originate after injury.

8. The true '*Cirroid Aneurism*' or '*Aneurism by Anastomosis*' is composed of vessels elongated, varicose and tortuous, very thin-walled, and more like veins than arteries in structure. The dilated vessels collected together form pulsatile thrilling tumours, soft and compressible. The vessels are usually described as arteries; but it is admitted that the dilatation may invade the arterioles and capillaries, and even spread to the veins, and there can be little doubt that many of the large pouched and pulsating vessels of a cirroid aneurism or aneurism by anastomosis are in reality pulsating veins. This being so, it is difficult, if not impossible, to point out any marked external differences between aneurism by anastomosis in its extreme development and aneurismal varix, and it is no wonder that Travers, Dalrymple, and others adopted this view of intra-orbital aneurism. The chief difference consists in the fact that in one case there is no arterio-venous communication, and that in the other this communication exists. No proof has been afforded as yet that 'aneurism by anastomosis' in its extreme development occurs in the orbit as a separate affection. It may spread to the orbit from the face or head; but further observations of a much more precise nature than those of Dr. Morton will have to be made to establish the affection in the orbit. On the other hand, arterio-venous aneurisms rest on so immovable a pathological basis, and attain so wide a development in severe cases, that this diagnosis naturally occurs to the mind in all cases where pulsating veins are found. In Brainard's traumatic case there was a loud blowing sound over the orbit and more or less over the head, the veins of the face were prominent, the arteries of the head and neck pulsated with unnatural force, thrill was heard over the whole head, there was an elastic and pulsating swelling at the upper and inner part of the orbit and root of the nose, and the small vessels of the forehead and side of the nose pulsated with a peculiar thrill. If aneurismal varix holds good for this case, it holds good for the severe cases of orbital aneurism which have been reported as ex-

amples of 'aneurism by anastomosis,' and the writer is inclined to believe that other cases of cirroid aneurism following an injury really belonged to aneurismal varix.

9. *Pulsating Sarcoma* of the orbit (previously described as encephaloid cancer) has many features in common with arterio-venous communications, or idiopathic and traumatic aneurismal varix. Loss of vision, exophthalmos, pulsation, noise in the head, and bruit ceasing when the carotid of the corresponding side is compressed, are symptoms of sarcoma and symptoms of aneurism. Its onset is often obscure, and the case will be still more obscure if the orbital tumour exists alone and if its development has followed an injury. Moreover, the sarcomatous tumour, projecting outwardly, may yield a soft, semi-fluctuating sensation, peculiarly liable to deceive even the experienced practitioner. In M. Lenoir's case, the carotid artery was tied, under the impression that the affection was aneurismal. The disease had followed a fall on the back of the head, and the only symptoms of differential value were the light whispering character of the bruit, the irreducibility of the tumour, and its extension towards the temporal fossa. Pulsation may be present without bruit, and the diagnosis will then be more obvious. In Mr. Nunneley's case of 'cancer of the orbit' the carotid artery was tied, and checked the progress of the disease. Here the diagnosis was rendered probable by the existence of multiple tumours, and by the continuation of the orbital tumour into the zygomatic fossa. By attention to this latter point, the character of the bruit, &c., the writer was able to diagnose malignant disease in a case in which it had been proposed to tie the carotid artery for suspected aneurism, and to ensure the abandonment of the proposal. Ligature of the carotid has several times been practised by American surgeons. In one or two cases a fatal result occurred; in others a combination of ligature with extirpation of the growth proved successful. Ligature checks for a short time the progress of the disease, but it is only to be advised in exceptional cases.

10. A *Meningocele* of small size may project at the internal angle of the orbit and be mistaken for a nevus or erectile tumour. This happened in M. Guersant's case, which was seen by many Fellows of the Surgical Society of Paris, who agreed in recommending treatment by thread setons. Cerebral symptoms supervened, and the child soon died. It was found, at the post-mortem examination, that the tumour was composed of a small portion of brain-substance

covered by the membranes of the brain, which had passed through the fronto-ethmoidal suture, and appeared at the inner angle of the orbit.

11. In Graves's disease, pulsation of the prominent eyeballs is absent. Derangement of the sympathetic system, or a morbid state of the lenticular ganglion, has no known connection with the production of symptoms resembling those of aneurismal varix of the ophthalmic vein.

12. The distinctive features of thrombosis of the orbital veins, aneurism of the carotid in the cavernous sinus, and aneurism of the ophthalmic artery before it enters the orbit, may be gathered from what has been stated above under the head of pathology.

Treatment.—In a small proportion of both traumatic and idiopathic cases, the symptoms of orbital aneurism have subsided in the course of weeks, months, or years by simple means, such as attention to diet and abstinence from stimulants, application of cold, exhibition of drugs like belladonna, veratrum viride, ergot, and digitalis, and mechanical compression of the pulsating tumour. To oppose the expectant treatment, we have Nélaton's case dying from hæmorrhage from the nose only, mechanical treatment having been employed; and Scott's case, saved from a similar fate by prompt ligation of the carotid. To these we must add several cases, in which the symptoms were aggravated after the lapse of months or years. The surgical means of treatment at our disposal are local compression of the tumour, digital and instrumental compression of the common carotid, galvano-puncture, subcutaneous injection of ergotine, injection of coagulating fluids into the pulsating veins, ligation of vessels within the orbit, with or without removal of the pulsating mass, and ligation of the carotid artery or arteries.

Local compression produced some benefit in three cases, and was either useless, too painful, or injurious by increasing the chemosis and congestion, in seven others.

Instrumental compression has failed in several cases. Glascott, however, in 1883, related a successful instance in a traumatic case. A man, forty-two, fell down an open hatchway. The night after the accident he noticed a whizzing noise in his head, which continued. A month after the accident his left eye began to protrude. When first seen, the upper lid was swollen, conjunctiva chemosed, and vision very much reduced. The ocular and conjunctival veins were enormously distended and varicose, and the

retinal veins were enlarged and tortuous. At the inner superior angle of the orbit a large vessel was seen pulsating. On applying a stethoscope, a quarter of an inch above the supra-orbital notch, a loud blowing murmur was audible, synchronous with the cardiac systole, and was not continuous. Patient was put on ten grains of pot. iodide, and compression of the left carotid was maintained by the patient with a compressor, made of a wooden knitting needle with its head protected by a firm pad. Compression was kept up by the patient for two minutes at a time, every quarter of an hour. Compression, begun on September 30, was kept up till December 21. The large vessel at the superior inner angle had ceased to pulsate. No pulsation was detected anywhere in the orbit, nor any bruit. There was old clot at the bottom of the anterior chamber, and there was no perception of light.

Digital compression of the common carotid was first practised by Gioppi. It failed in ten traumatic cases, and cured three out of six idiopathic cases. It may either be continuous or intermittent, and it is worth noticing that in the three successful cases (Gioppi, Scaramuzza, and Galezowski), as well as in Glascott's case, just related, it was only practised for a short period in the twenty-four hours, and not for many minutes at a time. In Gioppi's case, as compression caused faintness, it was only employed, for a minute or two at a time, by the convalescent patients in the ward, the patient herself, and the pupils. Pulsation and noises ceased at the end of the fourth day. In Scaramuzza's case digital compression, employed very cautiously on account of aortic disease, was practised for not more than five or six turns, the total period of compression being only seven hours twenty minutes. The eye had then entirely re-entered the orbit, and pulsation had ceased. In M. Galezowski's case, compression was practised every two or three days for fifteen or twenty minutes, afterwards increased to forty-five or sixty minutes daily. Marked relief followed each sitting, and, at the end of a month, the movements of the globe had returned, the eyelid was raised, and the chemosis was gone. An interruption of the treatment for about a fortnight took place; then it was recommenced, and continued for more than two months every two or three days. A month later, the protrusion had almost entirely disappeared, the patient heard no bruit, and none could be heard on auscultation over the cranium.

Digital compression of the carotid should not be practised, by any one person, for more than ten or fifteen minutes at a time without relief. It is by no means easy of efficient application by inexperienced assistants, but it is a valuable method of treatment, free from danger when applied with due precautions, capable of occasionally effecting a cure, especially in idiopathic cases, and serves as a valuable preparation for ligature by establishing anastomosing channels, and preventing disturbance of the cerebral functions subsequently to ligature.

Galvano-puncture is not well suited for application to a thin-walled aneurismal varix of the ophthalmic vein. It has twice failed in a traumatic case. M. Pétrequin's patient died after ligature and subsequent galvano-puncture, but whether from the former or latter method, or the combination of the two, is not clear.

Injection of ergotine subcutaneously was practised in the case of Schiess-Gemuseus and Socin, and produced nausea, vomiting, cedema, and increase of the tumour. There are no rational grounds for expecting success from this procedure.

Injection of a coagulating fluid into the pulsating tumour has been practised four times. In two traumatic cases (Bourguet and Desormeaux) a solution of the perchloride of iron was used and effected a cure, vision being restored. In Brainard's case, the lactate of iron effected a cure after the failure of ligature, but the eye was lost. Brainard had previously tried the effects of the lactate of iron in solution on a dog without ill effect, and he had also used it on the human subject, injecting it into the veins at the bend of the elbow. Each of the veins into which it was thrown was obliterated after a time, and converted into a fibrous cord. He considers that, while the perchloride of iron is a foreign substance causing coagulation of the blood, and is apt to be followed by gangrene and suppuration, lactate of iron is composed of elements which are natural elements of the blood, and acts by gradually causing thickening of the coats of the veins, converting them into fibrous cords and thus obstructing the circulation. In the writer's case, the quantity of perchloride injected (5 drops) proved to be insufficient to effect complete coagulation.

Injection of coagulating fluids in arterio-venous aneurism stands on a different footing from injection of a nævus, as the blood-current in the veins is reversed. It is only adapted for aneurismal varix of the ophthalmic vein and its branches, outside

the orbit. It is more painful than ligature and probably involves more risk to vision, as it may set up inflammatory mischief in the loose areolar tissue round the veins, which may spread to the cornea. It may also effect so much coagulation as to interfere with the requisite supply of blood for the maintenance of the ocular tissues. When injection is practised, pressure on the carotid should be maintained during the operation.

Taking account of those cases only of which the writer knows some of the particulars, *ligature of the common carotid* has been practised 56 times in 54 cases, the right carotid having been tied 21 times and the left carotid 33 times. In two cases the side is not stated. Of the 54 cases, 21 were idiopathic and 32 traumatic—the nature of the other case not being known to the writer. Of the 21 idiopathic cases in which ligature was practised, 12 were affected on the right side and 9 on the left; 4 died and 17 recovered. Two of the patients who died were females advanced in years, and both had atheromatous arteries. One, aged sixty-five, died on the sixteenth day from secondary hæmorrhage and cerebral disturbance; the other, aged sixty-three, died in fifty-two hours from cerebral causes only. A third (Critchett's) case was of a malignant nature, and the patient succumbed, some months after the operation, from repeated hæmorrhages from the orbit. The fourth patient, a female, aged only twenty-three, operated on by Dr. Morton, died suddenly, the day after the operation, from inflammation at the base of the brain. Of the 17 patients who recovered, 13 were cured of the aneurismal affection, vision being restored in 9, lost or not regained in 3, and not mentioned in the others. In 3 partial benefit resulted, vision being lost in 1, impaired in 1, and not mentioned in the other. In 1 (Frothingham's) the aneurismal affection subsided for a time. Pulsation returned in fourteen days. Three years later the disease was again urgent. The eyeball was enucleated and the tumour removed, and the patient recovered.

Of the 32 traumatic cases 5 died and 27 recovered. The ages of the patients who died were respectively seventeen, twenty-two, forty, thirty-three, and forty-two. One of the five was subjected to galvano-puncture subsequently to ligature, and the cause of death is not stated. In 3 cases the cause of death appears to have been pyæmia, 1 recovering from the operation, but returning to the hospital and dying at the end of three months. The

fifth patient (Dr. Morton's) died rather suddenly, from serous apoplexy, during the night after the ligature. Of the 27 patients who recovered after ligature of one carotid, only 17 were cured of the aneurismal affection of the orbit, 1 subsequently to injection, vision being lost or not regained in 6, and the bruit being noted as persisting in 4. In 8 of the 17 the cure was in all respects complete. In 1 the common and external carotid arteries were tied on the side affected. In 5 the operation was unsuccessful; 2 were subsequently cured by ligature of the opposite carotid, and 1 by injection of lactate of iron. In 5 partial benefit resulted, the symptoms being diminished but not removed in 3, and being removed for a time only in the others. In Velpeau's case, the symptoms were removed altogether on the left side but returned on the right. In Knapp's case, ligatured by Dr. Sands, the symptoms returned; the exophthalmos increased, the cornea sloughed, and the eye was lost by panophthalmia. The eye was enucleated and a large pulsating ophthalmic vessel (evidently the vein) ligatured at the apex of the orbit. The patient recovered. One case (Flatten's), whose nature is not known to the writer, was cured.

Taking the two sets of cases together, we have a total of 54 cases. Out of this number there were 8 deaths, for one death was unconnected with the operation, 5 failures to cure the disease, 9 partial successes and temporary removal of the symptoms. Of the 5 cases in which the operation failed, 2 were cured by ligature of the opposite carotid and 1 by injection. Of the 31 cases cured, vision was restored in 20, lost or not regained in 9. The bruit persisted certainly in 4, and probably in others not examined with the stethoscope.

The two cases in which both carotids were tied occurred in America. In one case, the interval between the operations on the two arteries was thirty days, in the other fourteen months. Vision appears to have been improved in the former case, but it had been lost and was not regained in the other.

Ligature of the common carotid is at present the most successful and satisfactory means of treating orbital aneurism. It should not be practised on patients advanced in years, or on those with heart-disease or evident atheromatous degeneration of arteries. The two cases operated on over sixty years of age succumbed, and if we deduct these as well as Pétrequin's case, in which the subsequent galvano-puncture may have been the real cause of death, there were 5

deaths in 54 cases, or rather 56 operations. One of the 5 deaths did not take place till three months after operation, and can scarcely be regarded as directly caused by it. Two of Morton's cases died suddenly within twenty-four hours, and were probably not in a fit state for operation, having already some inflammatory affection at the base of the brain. If these last three cases are included, the death rate would be about nine per cent.; if excluded, it would be under four per cent. The percentage of absolutely successful cases or cures would be about fifty-five.

Return of the symptoms after ligature may take place in three different ways. In cases of arterio-venous communication, the symptoms may return on the same side from want or deficiency of coagulation of the blood in the ophthalmic vein, carotid artery, and cavernous sinus, or clot may form temporarily and be washed away. Secondly, the symptoms may return either on the opposite side or in the outer part of the same orbit, after being cured on the inner side. Obliteration of the ophthalmic vein may have occurred on the side originally affected, but, the arterio-venous opening still remaining patent, the arterial blood is either pumped into the circular sinus and the cavernous sinus and ophthalmic vein on the other side, or through the emissary veins into the pterygoid plexus, and so may reach the same orbit again through the sphenomaxillary fissure. If there are two ophthalmic veins, one may be obliterated and the other become correspondingly enlarged, or both may expand together. Thirdly, in cases of true aneurism, the affection, which seems to have been a return on the opposite side, may be in reality the formation of an aneurism *de novo*. Although ligature of the carotid seems to offer the best chance of recovering useful vision, when vision is impaired or threatened, it is by no means an infallible remedy. If vision is lost or nearly lost before operation, it will rarely be regained; if only impaired it will probably improve, but there are one or two cases in which sight was lost subsequently to ligature.

The causes of loss of vision in cases of orbital aneurism both before and after treatment deserve attention. In some traumatic cases, the optic nerve may be torn across at the time of the accident; in some idiopathic cases, the damage to its structure may occur from pressure of a circumscribed aneurism or pressure of blood-clot when an aneurism is ruptured. Pressure on the ophthalmic nerve may occasion, directly or

indirectly, ulceration of the cornea. Vision has been lost in cases treated simply, treated by digital compression, treated by injection, and treated by ligature. The cornea has grown hazy after ligature and recovered itself; it has ulcerated after ligature, and the eyeball has atrophied more than once; it has ulcerated and healed before ligature, and it has ulcerated before ligature and healed afterwards. Vision, almost lost before injection of perchloride of iron, has been regained afterwards; injection has also been followed by ulceration of cornea, severe inflammation of the eye, loss of the humours and collapse of the globe. In all cases, vision rests on a precarious foundation, and it is impossible to predict positively whether the treatment recommended will succeed in preserving or restoring it in any particular case. Delay in treatment certainly endangers vision. The altered conditions of nutrition render the preservation of transparency in the media and of the integrity of the retina precarious, whilst treatment involves the possibility of excessive coagulation in the vessels, and interferes with a due supply of blood. On the whole, the evidence appears to be in favour of early resort to ligature, as affording the best prospect of restoration or preservation of sight. In case of failure of ligature on one side, the question of ligaturing the opposite carotid will present itself for consideration, and may be answered by first ascertaining the effect of digital compression of the vessel. Ligature of the opposite carotid will also have to be compared with other available methods, such as coagulating injections.

Ligature of the aneurismal ophthalmic vein at the apex of the orbit might be feasible and successful, in selected cases.

Ligature of pulsating vessels in the orbit has been attempted or practised on three occasions. In 1860 M. Passavant, diagnosing a traumatic aneurism of the lacrymal artery in a girl of nine, who had been wounded by a knitting-needle thrown at her in a rage by her sister, attempted to reach and tie the vessel by dissecting the soft parts from the external wall of the orbit, and resecting the bones sufficiently to allow the finger to penetrate behind the globe. At the apex of the orbit, very deeply and on the inner side of the optic nerve, the finger encountered the pulsations of an aneurismal pouch, but all attempts to tie it were vain. The child remained after the operation in the same state as before.

Arterio-venous aneurisms of vessels within the orbit are almost unknown. In

1875 Mr. Lansdown of Bristol reported 'a case of varicose aneurism of the left orbit cured by ligature of the diseased vessels.' A few cases have some claims to be regarded as instances of 'aneurism by anastomosis.' Noyes, in an idiopathic case occurring in 1881, tied the angular artery (?) and exposed a protruding pulsating vessel at the inner and lower side of the orbit. The latter was then cautiously dissected up and traced into the cavity of the orbit, until it reached the groove for the infra-orbital nerve, where it dipped down. A ligature was put about this end and the vessel excised. It proved to be a vein and was larger than a crow-quill. In eighteen days both ligatures came away. In fifty days the patient was discharged. Pulsation ceased, and the eye returned to its place. Three other cases, in which the eye and the pulsating vessels have been enucleated, were operated on by Frothingham, Knapp, and Morton respectively.

WALTER RIVINGTON.

ORCHITIS. See **TESTIS**, Diseases of the.

OS CALCIS, Excision of the.—It is not uncommon to meet with cases in which the os calcis alone of the tarsal bones is the seat of degenerative disease; and when any large part of its central tissue is softened, or a considerable portion of its surface is carious, the bone may with great advantage be dissected out from its connections with the rest of the tarsus, and a most useful foot be left.

Operation.—The best method of removing the os calcis is that recommended by Mr. Holmes. An incision is made on a level with the upper border of the bone, commencing at the inner edge of the tendo Achillis, and passing forwards to a point a little in front of the calcaneo-cuboid joint, which lies midway between the outer malleolus and the base of the fifth metatarsal bone. The incision should be made down to the bone, and divide the tendo Achillis. Another incision is then to be drawn across the sole at a right angle to the first, and at a point corresponding to the calcaneo-cuboid joint; it should stop short of the outer border of the grooved or internal surface of the os calcis, so as to avoid the posterior tibial vessels. The flap thus formed is dissected up and the calcaneo-cuboid joint freely opened; then the connections of the calcaneum with the astragalus are divided. The bone should next be levered out of its bed to some extent with an elevator, and grasped with the lion-forceps, by which it

is to be turned aside, so that the soft part can be carefully cleared from its inner side. Any remaining ligamentous attachments being now divided, the bone can be pulled away.

The operation will be much facilitated by the use of an Esmarch's bandage, which enables the position of the joints to be more easily seen. The flaps are to be brought together with sutures, a drainage-tube inserted, and the limb placed upon a splint, with the foot at a right angle to the leg. The gap left by the removal of the bone fills up with dense fibrous tissue. The tendo Achillis takes a fresh attachment, and as a rule a perfectly useful foot results, the only deformity in which is a slight elevation of the heel.

Many surgeons prefer to dispense with the sole incision altogether, and prolong the horizontal cut on the inner side of the foot to a point corresponding with the calcaneo-cuboid articulation on the outer side. The advantage of this method is that the scar is not exposed to pressure.

Another method of removing the os calcis is that of turning back a flap from the heel, such as is made in Syme's amputation, the incision running from the tip of the outer malleolus to a corresponding point on the inner side of the foot; the joints are then opened and the bone dissected out. This, however, is a much less convenient plan than that first described.

The subperiosteal method is tedious, and does not seem to give better results than the ordinary operation.

J. WARRINGTON HAWARD.

OS INNOMINATUM, Fracture of the. *See* PELVIS, Injuries of the.

OSMIDROSIS. *See* HYPERIDROSIS.

OSTEO-ANEURISM.—It is doubtful if this term ought still to be preserved; for all the cases of pulsatile tumours of bone which have been recorded of recent years, since the general use of the microscope, have proved, when this method of investigation has been adopted, to be central sarcomata. A large proportion of the myeloid and round-celled sarcomata, growing in the cancellous tissue of bone, pulsate distinctly, and, before the microscope was employed for the examination of these tumours, were often described as osteo-aneurisms, on account of their pulsation and the apparent absence of anything more solid than blood-clot. But in the outlying parts of such tumours, new-growth, of the sarcomatous type, has, of recent years, always been found.

Under **TUMOURS OF BONE** a clinical description of these endosteal growths is given, to which the reader is referred for further information. Their pulsation seems, in most cases, to be due to the large number of new and dilated vessels which they contain. In some of the myeloid sarcomata numerous cystic cavities are found, filled with blood in different degrees of consistence, into which the enlarged vessels probably open; but the growth is so soft and diffuent that an accurate examination of the centre can very rarely be undertaken. The more solid tissue in the outlying and peripheral parts of the growth is that which is generally examined, to demonstrate the nature of the tumour; and this examination, as stated above, has almost invariably proved that the growth is one of the sarcomata, most frequently the myeloid or round-celled.

A vascular tumour has also been described as occurring in the flat bones, such as those of the skull in young children, resembling in its general structure the arterial erectile growth that is occasionally seen in the soft parts of the face and scalp.

H. H. CLUTTON.

OSTEO-ARTHRITIS.—A chronic disease of the joints, occurring usually in persons past maturity, and giving rise to extensive changes in the shape and texture of the articular tissues, with corresponding interference with function.

The striking features of this disease are the altered shape of the joint surfaces, which are worn away in some parts and irregularly nodulated in others; the softening and destruction of ligaments, allowing displacement of the bones; the loud and easily felt crepitus on movement; and the progressive loss of mobility.

The disease is seen chiefly in ill-nourished persons of declining years, and is said to be more common in those of rheumatic ancestry or predisposition. But it may be observed in younger persons who have been subjected to depressing influences or to injury, and is occasionally met with in children. When it does occur in the young, the disease is extensive in its distribution and comparatively rapid in its progress. The writer has seen two very severe cases in female children before puberty.

The disease often seems to have its origin in injury, a sprain or blow upon a joint eliciting the first symptoms; yet the predisposing diathesis is doubtless also essential for its production, because the inflammation started by the injury leads to

results entirely different from those of ordinary traumatic arthritis, and, moreover, other joints besides the injured one subsequently become affected.

Osteo-arthritis is probably one of the few joint-diseases which commence in the articular cartilage. The earliest changes are observed in this tissue, which loses its proper smoothness and pearly grey colour, and becomes roughened, of dull yellow tint, wasted, and worn away at the points of greatest friction; while, at the same time, irregular and nodular thickening occurs at its edges, where least subjected to pressure. After a time the synovial membrane becomes vascular and thickened, and there is sometimes considerable effusion into the joint. Fluid distension of the joint is not, however, usually of long duration, nor is it a prominent symptom in this affection. As the disease progresses the cartilaginous outgrowths ossify, and similar formations occur about the margins of the joint-surfaces, especially at the insertion of tendons; at the same time, the wearing away of the cartilages exposes the bones, the ends of which become flattened out and the articular cavities enlarged, while their surfaces become hard, dense, and polished.

The neighbouring ligaments and tendons become softened, stretched, wasted, or completely destroyed; so that, in addition to the great alterations of shape which the bony outgrowths and flattening out of the joint-surfaces have produced, more or less displacement occurs. Moreover, some of these cartilaginous or bony formations may become detached into the cavity of the joint, and thus give rise to a so-called 'loose cartilage.'

The *symptoms* of course differ with the stage of the disease, and it is important to remember that the affection varies greatly in its rate of progress. At the commencement, aching pain and stiffness and crackling in the joint are the chief characteristics, to which, after a variable time, are added nodulation and displacement of the joint-surfaces, and alterations in the axes of the limbs.

It is the rapid occurrence of these later changes, especially after injuries, which gives rise, sometimes, to suspicions of fracture and to the erroneous diagnosis of partial dislocation. In the shoulder, the long tendon of the biceps may be completely divided, the glenoid cavity much enlarged, and the head of the humerus altered in shape, so that the natural outlines of the joint are not recognisable; and movement, which is too free in some directions and re-

stricted in others, is accompanied by loud crepitus. It is easy to see that these are conditions which, especially if they ensue upon an injury, may be misinterpreted by the sufferer, and possibly by his attendant.

So also in the wrist, the osteal changes may simulate displacement of the carpal bones; and in the hip-joint the flattening of the head of the femur, the shortening of its neck, the enlargement of the cavity and roughening of the margin of the acetabulum, and the destruction of the round ligament give rise to symptoms which may be mistaken for intra-capsular fracture.

It is well to bear in mind then, that in elderly persons, and in those predisposed to this disease, a fall on the hip, a fracture of the lower end of the radius, a sprain of the knee or a blow on the shoulder, are injuries which, amongst others, are frequently followed by the development of osteo-arthritis.

Treatment.—In the treatment of osteo-arthritis it is of the first importance to improve the nutrition of the patient, which will almost always be found defective. When, therefore, injuries such as those alluded to occur in elderly persons, or in those prematurely senile, or who are ill-nourished or suspected to have any predisposition to osteo-arthritis, a generous diet, in which oil and fatty food should have a large share, should be given during the treatment of the injury; while, at the same time, the nutrition of the injured limb should be promoted by warmth, friction, and other suitable measures.

In the early stages of the disease, warm douches, friction with oleaginous liniments, soft, warm supports to the joints, applied so as not to interfere with the circulation nor with moderate use of the limb, are the appropriate local treatment. Cod-liver oil, sulphur, arsenic, or guaiacum may be given internally. If, in spite of such measures, the disease is progressive, it is worth while for the patient to seek one of the sulphurous spas, where the treatment is often productive of great benefit.

In the advanced stages of the malady, attention to the general nutrition and the maintenance of warmth are the chief aids, but the local changes are of course irremediable. See CHRONIC RHEUMATIC ARTHRITIS; CHARCOT'S DISEASE.

J. WARRINGTON HAWARD.

OSTEIOD CANCER. See CARCINOMA.

OSTEOMA.—Osteomata are tumours composed wholly of bone, and attached by their bases or peduncles to some part of

the bony framework of the body. In some rare instances they have been found in the soft parts as distinct and discontinuous tumours, but these are exceptions with which there is not space here to deal. Under *Exostosis* will be found a description of osteomata which grow from or are attached to the different parts of the skeleton; and under *Jaws*, Diseases of the, the forms of osteoma of which these bones are the frequent seats have been described. Tumours composed of other tissues, in which ossification is present, will be found described under *ENCHONDROMA* and *SARCOMA*, those only in which ossification is complete being spoken of as osteomata.

H. H. CLUTTON.

OSTEOMALACIA.—Osteomalacia is a disease of the fully formed adult bones, in which bending or fracture of one or more of the osseous structures is liable to occur, with considerable deformity. Under *FRAGILITAS OSSII* will be found a description of the various forms of atrophy in which fracture is likely to take place, and which at times have been mistaken for osteomalacia.

Causes.—Very little has been ascertained as to the definite causation of this disease, but the circumstances predisposing to its occurrence (or, to speak more certainly, the circumstances under which it most frequently arises), are well known. Mr. Durham, in the *Guy's Hospital Reports*, 3rd series, vol. x., 1864, has carefully analysed Litzmann's cases, which number 131, and has added the particulars of 14 other cases, making a total of 145. The most striking feature in this analysis is the fact that out of a total of 145 there were 132 females and only 13 males, and 'of the females 91 were first affected during pregnancy, or very shortly after childbirth.' As regards the time of life, 'the great majority began to suffer when between twenty-five and thirty-five years of age.' The situation of the disease is also remarkable, for, in those cases connected with pregnancy, the pelvis and the lower part of the spine were the first to give any indication of the disease, and, in those unconnected with pregnancy, the symptoms very early manifested themselves in the lower extremities. After discussing the various circumstances in the life-histories of these patients to which the disease has been at times attributed, Mr. Durham thus expresses his own opinion:— 'In the histories of all, without exception, mention is made of the existence of some influence or other, or of some combination

of influences, well known to be capable of producing great general depression of the nervous system.' It would be out of place here to discuss the many theories that have been propounded to explain the reason why the bones should be so extensively diseased, whilst the rest of the tissues remain to all appearances unaltered. Nor is there space to enumerate the chemical theories which have been advanced, by different authors, to explain the absorption of the inorganic constituents of bone and the appearance of salts of lime in the urine. Suffice it to say, that lactic and phosphoric acids have each been considered to be the means of this alteration in the condition of the bones.

Pathology.—Osteomalacia consists essentially in a softening of the bone-tissue. The earthy matter is in the first place absorbed, leaving the organic matrix with only a faint indication of its lacunæ and canaliculi. The appearance is similar to that which is produced when bone is soaked in hydrochloric acid for a microscopical specimen. This change is first seen in the bone next the Haversian canals and medullary spaces, while the central portions of the trabeculæ have still almost the appearance of healthy bone. The decalcification proceeds more rapidly in one direction than another, and often produces semicircular excavations like Howship's lacunæ in rarefying osteitis. The central portions of the trabeculæ are gradually affected in a similar manner, while the parts already decalcified become soft and jelly-like. The Haversian canals thus gradually enlarge till the compact substance resembles spongy bone, and this again is transformed into a soft gelatinous tissue without any osseous trabeculæ at all. This process goes on till the whole of the interior of the bone is converted into a substance resembling jelly, leaving, however, a thin layer of the cortex beneath the periosteum unaffected. The fact that this outermost layer of the cortex, which is often not thicker than cardboard, remains unaffected, deriving, as it does, its nourishment from the periosteum, lends support to the theory that the disease starts in the medullary cavity. The vessels, no longer contained in rigid walls, allow their blood to escape, so that a reddish brown semi-fluid pulp is produced, resembling that of the spleen. This parenchymatous hæmorrhage is a very constant phenomenon in osteomalacia. Microscopically, this pulp is found to contain numberless blood corpuscles, cells of various shapes and sizes, but

mostly small, a considerable number of oil-globules, and granular matter.

The *symptoms* are at first somewhat obscure, the patient complaining only of pain, which is nearly always described as rheumatic. It is deep-seated and increased by pressure and motion; but there is nothing very definite in its character by which one can tell the onset of the disease. General lassitude and inability to make any exertion are commonly complained of, but it is not possible to say that osteomalacia is present till some very obvious deformity points out, only too clearly, the nature of the affection. Diminution of stature, and a peculiar gait in walking, may also at times be observed, the latter being apparently induced by a feeling of want of security. But all these symptoms could, at most, only arouse the suspicions of the medical attendant. The real state of the case is eventually revealed by the discovery of one or more bones becoming bent or broken from some very trivial accident. Or, possibly, the practitioner may first be made aware of the condition of the bones by an examination of the pelvis during parturition. The iliac and pubic bones are not infrequently the only parts at first affected. The promontory of the sacrum is thrust forward by the weight of the body, while the sides of the pelvis are made to approximate from the same cause acting upon the two femora. The pelvis thus assumes the beaked shape so characteristic of the deformity in this disease. It is needless to point out the serious obstacle which this condition of the pelvic outlet causes to the safe delivery of the child. Cæsarean section is, in many cases, the only resource of the obstetrician. The bones, being soft, however, have been bent and altered in shape by the hands of the medical attendant, and delivery effected through the vagina.

The spine also is oftentimes very seriously deformed, and chiefly by the great increase of its natural curvatures, which may be so much exaggerated as to assume somewhat the shape of the letter S. The ribs also may bend or break from the action of the respiratory muscles and the use of the upper extremities. They commonly yield and bend outward not far from the spine, and are again thrust forwards just outside the sternum; and between these two points, at the axillary line, they are bent inwards. The arms are thus lodged in trough-shaped hollows, and tend to compress the lungs within the chest. The bones of the extremities have also been

bent and broken in many places, allowing the feet to touch the head in some extraordinary instances. We may thus have, in extreme cases, the most exaggerated deformities of the skeleton of which the human body is capable. But it is quite possible for the disease to be confined to the pelvis and the lower part of the spine, as has been shown in the statistics quoted above. The urine has almost always contained an excess of lime-salts, pointing to the conclusion that the inorganic constituents of bone are eliminated through the kidneys. Fever has also been noticed towards the termination of many of the cases, but in the early stages it has generally been absent.

It is impossible to give a very definite or decided opinion as to the mortality of osteomalacia. A very large proportion of the deaths have occurred during parturition from the mechanical difficulty to which the deformed pelvis has given rise. But it does not appear that the disease itself directly causes death. The patients are necessarily confined to bed, and as a consequence their vital powers are considerably diminished. They are thus exposed to intercurrent maladies, which may at any time prove fatal in such enfeebled constitutions as are necessarily produced from the conditions of the disease. Provided the thorax and spine are not involved, the patients may live a very long time in their crippled and bedridden condition. But if the ribs give way and cause compression of the lungs, or the softening of the bodies of the vertebræ interferes with the integrity of the spinal cord, a fatal termination may quickly supervene and cut short a long and tedious complaint. If none of these casualties occur, the patient may eventually die of exhaustion and simple failure of the vital powers, in a manner similar to that seen in extreme old age.

Recovery or obvious improvement is stated to have occurred in 22 out of the 145 cases already quoted from Mr. Durham's article. But they appear to have been nearly all connected with pregnancy, and the disease was confined to the pelvis and the lower part of the spine. How far such cases of osteomalacia are really capable of recovery, further experience is required to show.

Treatment.—There is very little to be done in the way of treatment. In the early stages, freedom from anxiety, absolute rest, good diet, and general tonics such as iron, quinine, and cod-liver oil, should be recommended. Salts of lime would seem only to be capable of doing harm, for the system

is trying, through some error of nutrition, to get rid of what is already present in the tissues, as is evidenced by the condition of the urine; and to throw more upon the organs already overburdened with these salts, only tends to increase their difficulties. Should a definite fracture occur, it must be treated on ordinary principles, in the expectation that it will unite, as it generally does in the early stages of the malady. In extreme cases, there is really nothing that can be recommended to arrest the progress of the disease.

H. H. CLUTTON.

OSTEOMYELITIS is an inflammation of the medullary canal and the tissue lining the cancellous parts of bone. It may be divided into acute and chronic osteomyelitis. Of the acute there are two very distinct varieties.

SIMPLE ACUTE OSTEOMYELITIS is generally caused by some definite injury to the bone, as in fractures or gunshot wounds. The inflammatory exudation takes place as it does in other tissues, and may undergo the same changes of resolution, suppuration, or organization. It occupies the tissue lining the cancellous framework of bone and, in simple fractures, forming the internal callus which will be found described in the pathology of this form of injury. In compound fractures, and after amputation, it often terminates in suppuration or necrosis of a limited portion of the cancellous tissue. This simple form of inflammation, confined as it is to a small portion only of the medullary canal, gives rise to no symptoms to distinguish it from the particular injury of which it plays only a secondary and unimportant part. The treatment may be gathered from what is said, in the following sections, as to the best means of preventing the diffuse form of the disease.

ACUTE DIFFUSE OSTEOMYELITIS is a much more serious complaint, corresponding to the acute diffuse periostitis which it sometimes accompanies. They are both thought by many surgeons to be infective or due to some specific virus. This is the form of inflammation which is generally meant when the term osteomyelitis is used, the simple inflammation being usually omitted from consideration, as having only a pathological interest.

Causes.—An *idiopathic* form of this disease, which is described as occurring in other countries, is very rare in England, except in so far as it may accompany and be a part of acute diffuse periostitis. The *traumatic* variety is, however, well known

in civil practice in England, and is especially dreaded by military surgeons in time of war.

Amputations, compound fractures, and gunshot injuries involving bone are the cases in which it is prone to occur. Decomposition of the discharges of a wound communicating with the medullary canal is undoubtedly, in most cases, the essential cause. It is, consequently, much less common in the present day, when so much is done, and that successfully, to prevent putrefaction and decomposition of wounds. Erysipelas and hospital gangrene and like infective inflammations may attack the medullary canal, but are scarcely likely to do so unless the discharges are in a septic condition. The state of things which then arises does not differ clinically from the disease we are now considering.

Pathology.—The simple mechanical process, by which this form of osteomyelitis takes place in a decomposing, suppurating wound, is easy to understand, without looking for a specific virus as an explanation. The patulous, thin-walled veins, lying embedded in such a rigid inelastic material as bone, at the bottom of a deep and suppurating wound, may very easily become distended with pent-up inflammatory exudation, which, for want of a ready outlet, may decompose and give rise to that septic mischief which we know and recognise as one of the chief constitutional signs of osteomyelitis. From the part thus affected the inflammation may spread to the adjoining medullary tissue, and the products of this inflammation, finding no outlet, may so arrest the circulation as to cause necrosis, or decompose and still further spread the mischief. Finally, the whole of the medullary canal, from one end to the other, may be affected in this way. Putrefaction of a wound may thus be alone responsible for a diffuse osteomyelitis, without the intervention of a specific virus. The veins filled with decomposing septic material may very easily give rise to embolic pyæmia, for they cannot collapse, and thus quickly become thrombosed. The thrombus softens from decomposition, and particles becoming detached enter the circulation, to be arrested in a distant part of the body. The patient may, however, especially after an amputation, where there is a more open surface for the escape of the inflammatory and decomposing products, live through these dangers. More or less extensive necrosis is then almost certain to follow, involving the cancellous tissue and the inner layer of the compact bone. The

long ferrule of bone, withdrawn in the form of a sequestrum from a stump some months after an amputation, is the common and most favourable result of this diffuse osteomyelitis.

Symptoms.—Deep-seated swelling of the soft parts covering the bone affected, whilst the skin remains almost in its natural condition; severe, dull, aching pain and much tenderness on pressure, are the chief local symptoms. Profuse discharge of dirty-looking, offensive pus from the wound or stump, increasing in quantity as time goes on instead of becoming less, as it should do under healthy conditions, would add to the probability of the medullary canal becoming inflamed and the source of all the trouble. Where the bone is exposed and capable of being examined, the periosteum will be found swollen, vascular, and detached from its connections. It may also be seen, as in the case of the skull, to be dry, yellow, and dead. If the medullary canal can be examined with a probe, as in the case of a stump, it will be found soft and yielding. But, oftentimes, there will be nothing by which to distinguish such a case from simple septicæmia or pyæmia. In fact, little can be said in most cases from the local symptoms; and we judge rather from the signs of septic mischief that there must be some source of infection. If the appearance of the stump be not inconsistent with some deep-seated mischief in the bone, we think it not improbable that the medullary tissue, although invisible, is the source of such severe constitutional symptoms. Fever of a septic type, with profuse sweats and much depression, are the principal features of this condition to which we are alluding. The temperature will probably be very high, between 103° and 105° Fahrenheit. Rigors may also occur and be frequently repeated. All the symptoms of pyæmia and septicæmia may become established, and the patient sink from rapid poisoning, or linger on with multiple pyæmic abscesses.

Treatment.—In the case of wounds and operations involving bone, let the disease itself be avoided by thorough cleanliness, and by that most perfect form of cleanliness—Listerism. If this be carried out in principle, although possibly not in absolute detail, decomposition will be prevented, and an almost absolute guarantee will be obtained that the mischief has not entered through the wound.

Other superficial and insignificant wounds may, however, be the channel through which septic poisons enter the cir-

culatation, and then decomposition may ensue in spite of all antiseptic precautions. We are not now speaking of those cases in which acute diffuse periostitis (or acute necrosis), with accompanying osteomyelitis, takes place without any wound whatever.

Granted then that putrefaction has occurred and the symptoms of osteomyelitis have ensued, what treatment is to be adopted to arrest its progress and prevent the onset of pyæmia? The two diseases are so liable to glide insensibly into one another, that whatever is done must be done quickly. First and foremost, a free outlet must be given to any pent-up discharges. In the case of a stump, the openings should, if small, be enlarged, and a drainage-tube be introduced. In the case of a compound fracture, an effective counter-opening may be required, so that the pus may escape as fast as it is formed. Then the question arises whether more than this can be done.

Amputation has been resorted to, with good results; but it must be done early, before pyæmia has become fully established, or the operation will be of no practical use. Some surgeons have asserted that, if amputation is performed, it is useless to do less than remove the whole bone—that is, to do exarticulation at the hip if the case be one of osteomyelitis of the femur. The writer of this article has, however, seen good results after removal of a portion of the bone, where the whole was not diseased. If amputation has been resolved upon, the decision as to the amount to be removed should rather rest upon the condition found upon examination of the end of the bone. If, after its exposure and examination with the finger, the periosteum is found extensively retracted, and the probe introduced into the medulla encounters nothing but pus and dead bone, the whole of the shaft should, if possible, be removed. When the probe comes rapidly upon sound and bleeding medulla, a portion only of the shaft need be taken away. Should, however, the sawn surface be still unhealthy, another section must be removed. In the case of the femur of an exhausted patient, it might be desirable, in the more extensive variety above-mentioned, to saw through the bone just outside the joint or through the trochanters.

Another and less severe operation has of late been suggested, and certainly deserves a trial in any case in which, for some reason, amputation is unsuitable. It consists in scraping out the whole of the diseased medulla and introducing iodoform into the canal. As far as general treatment

is concerned, the same rules apply here as in other exhausting febrile diseases. The patient must be supported with a stimulating, nutritious diet, and every method tried to keep his flagging powers from failing.

CHRONIC OSTEOMYELITIS.—Chronic inflammation of the medullary tissue takes place most frequently in conjunction with chronic osteitis and periostitis. *See* OSTITIS. It produces, however, no symptoms in these cases, except such as are common to the general inflammation of the whole thickness of the bone. The results of this condition are well seen in the filling up of the medullary canal in osteosclerosis. It sometimes takes another form, and terminates in suppuration or necrosis of a small portion of the cancellous tissue, producing the disease known as chronic ABSCESS OF BONE. H. H. CLUTTON.

OSTEO-PLASTIC RESECTION. *See* JOINTS, Excision of.

OSTEOPOROSIS.—Strictly speaking, osteoporosis is a spongy, porous condition of bone resulting from rarefying osteitis. The specimens in our museums are mostly enormously thickened skulls, in which the increase in size is almost entirely due to a development of finely porous and reticulated bone. In fact, their appearance is exactly similar to the condition described under OSTITIS DEFORMANS, and conveys the impression that if the history were complete, or if the whole skeleton could be examined, these thickened skulls, which were labelled many years ago as osteoporosis, would now be described as cases of osteitis deformans.

Besides the general effect produced by this disease, which is described elsewhere, a bone may become osteoporotic from local causes. An aneurism, or a tumour which only secondarily presses upon, but has not started in, the substance of a bone, may induce a local osteoporosis. But the term is more generally applied to the condition alluded to above, which arises without known cause, and affects many bones at the same time and in the same manner. H. H. CLUTTON.

OSTEO-SARCOMA. *See* SARCOMA.

OSTEOTOMY. — *Definition.* — Osteotomy, in its broadest acceptation, may be defined as the process of making a section of bone. It is, however, generally employed in a much more restricted sense, the term being applied to such divisions of bone as have been proposed and undertaken for the

relief of deformity, for the rectification of badly united fractures, and for the straightening of limbs which are fixed in bad positions by ankylosis.

Instruments.—When a surgeon is about to perform an osteotomy, his attention is directed towards the kind of instruments required, and the success of the operation depends in great measure on their proper selection. A variety of instruments has been employed, but the choice practically lies between the saw and instruments of the chisel order. Some surgeons prefer the saw to the chisel, as they believe that it is much more easily used, and they state that it is equally efficient. Langenbeck believed that the bone-*débris* left by the saw in the wound was apt to excite irritation which led to suppuration; and though this result does not necessarily follow, still, as it is an element of risk, it is better to avoid it. In the selection of an instrument, the desideratum is to secure one which will effect the osseous division with the least disturbance of the soft parts. When the saw is introduced by a subcutaneous wound for the performance of an osteotomy, there is the danger of laceration of the soft parts on either side of the bone while the saw is in action, besides the likelihood of air being pumped into the tissues by the to-and-fro movement. The chisel is not liable to these objections. Once the cutting edge is passed through the soft tissues to the bone, there is nothing further to fear; it in no way lacerates the soft parts, and it makes a fine, clean, osseous incision without leaving *débris*. It is, however, a most powerful instrument, and its proper selection and method of use are highly important to a successful issue of the case.

The instruments used by the writer are of two kinds, the chisel and the osteotome, the former being of the same form as the carpenter's, though different in temper; the latter being shaped like an attenuated double inclined plane. The chisel is used for paring, shaving, and cutting out wedges of bone, such as removing a cuneiform portion from the tibia in anterior curvature. The osteotome is used only for making simple incisions, or wedge-shaped openings, without removal of bone. It is advisable that anyone wishing to use these instruments should practise on the subject or on the bones of animals, so as to familiarise the hand and acquire the necessary dexterity. The surgeon should himself see that the instruments are scrupulously clean, before he uses them on the living body. If they are used while dirty, they will pro-

bably clean themselves in the wound, leaving in the soft parts or on the bone the foreign substance, and so possibly inoculate the tissues with decomposing matter. The only other instruments required are an ordinary sharp-pointed scalpel, suitable for penetrating the tissues to the bone, a couple of blunt hooks, and a mallet of hard wood, such as *lignum vitæ*.

The Operation.—The patient ought to be placed fully under the influence of an anæsthetic, and this should be maintained during the performance of the operation, and until the limb is securely fixed in splints. After the patient is fully anæsthetised, the limb is rendered bloodless. This is best done by the application of a bandage of elastic webbing, applied from the distal extremity of the limb to above the seat of operation, and then fixed at the most convenient point on the proximal aspect. The limb is then placed on a sand pillow. The sand pillow used by the author is eighteen inches by twelve; the case being filled with sand just sufficiently to enable it to be shifted from one part of the bag to another, without leaving any portion empty—a moderate fulness without distension. The sand is moistened just before the operation, to prevent the escape of dust and to produce greater cohesion between its particles, so that it will more readily retain the form or mould imparted to it. It is then covered with a sheet of jaconet or other waterproof material, and laid on a table. The limb is then embedded in the pillow in the manner suitable for the particular operation.

In order to introduce either the saw or the osteotome, a wound in the soft parts must be made. This wound ought to be a sharp, clean, single incision, produced by one stroke of the instrument wherever this is practicable. Dissection ought to be avoided, the situation in which the incision is to be made being chosen so as to get to the bone as directly as possible. The direction of the incision should be in a line with that of the muscular fibres about to be penetrated. The situation of the wound in the soft parts ought to be selected so as to avoid cutting, not only the larger vessels, but also the smaller ones, when this can be done. As to the extent of the incision, this depends greatly on the surgeon, whether he wishes to see what he is doing, or whether he can trust to the tactile sensations conveyed through the instrument to his hand, as a sufficient guide. If the latter, the wound need only be large enough to admit the osteotome; if the former, it would require to be a couple or more inches in

length, according to the depth of the tissues. When a surgeon commences to practise osteotomy, it would be well for him to make a large incision, one sufficient to enable him to examine the bone with the finger, or even to see the bone; in this way he performs his operation with more confidence, and the extent of his incision is an element of safety, inasmuch as it provides a ready exit for discharge—blood or serum—which otherwise might be pent-up in the parts, causing distension. After he has gained a little more experience, the osteotome may be used as a probe (the saw will never answer this purpose), the sensations conveyed through the instrument being sufficient to enable the operator to ascertain all that can be known by the introduction of the finger. When the operator has reached this stage, all that is necessary is to make an incision which will enable the osteotome to reach the bone—from half an inch to an inch long, according to the breadth of the blade. By operating in this way the tissues are much less disturbed, there is less effusion of blood or serum, and much less need of drainage.

In removing wedges of bone, the wound must be larger. But, in operating upon the tibia, the incision need not be larger than the base of the wedge to be removed, as the skin moves freely over the surface of the bone, and may be shifted up or down to suit the convenience of the operator. When small wounds are made, the knife ought to remain *in situ* until the saw or the osteotome is introduced by the side of it to the bone, the knife acting as a guide. When the osteotome has reached the bone, it should be turned in the direction in which the osseous incision is to be made, care being taken while doing this not to denude the bone of periosteum.

The osteotome ought to be used in such a way as to direct its cutting edge away from any important soft structures, which it may be necessary to avoid. As the osteotome has blunt sides, it may be used to lever the soft tissues aside, keeping, meanwhile, the cutting edge of the instrument in close contact with the bone. After a little practice, the osteotome acts as a probe, and when once the tactile impressions conveyed through this instrument are cultivated, it becomes a delicate indicator of the state of the bone, the precise relation of the osteotome to it, and the extent of the osseous incision. But when the osteotome has been embedded in the bone for an inch or two, its delicacy of touch is lost, and it no longer remains a precise indicator of what is in

contact with its cutting edge. This is due to the manner in which the sides of the instrument are pressed on and caught by the bone; the amount of lateral pressure varying according to the amount of the osseous tissue through which the instrument passes. This may be easily rectified by introducing a finer instrument by the side of the thicker one first used, and withdrawing the latter. The finer instrument is then placed in the osseous groove made by the thick one, but, being a more attenuated wedge, its sides are not pressed on, so that it acts as an indicator of the kind of tissue in immediate contact with its cutting edge. This can be repeated, in a thick bone, by the substitution of a third instrument of still greater acuteness.

When using the osteotome, it ought to be grasped firmly in the left hand, steadied by the inner border resting on the patient's limb. The surgeon ought to cut to, instead of from, himself. Thus, if the surgeon is operating on the inner side of the left limb, he ought to stand on the left side of the patient, and cut towards himself. If the surgeon, instead of following this instruction, should hold the osteotome loosely, a slightly uneven blow with the mallet would outweigh his grip, and might cause the instrument to slide along the surface of the bone, peeling the periosteum, or causing a more unpleasant accident, such as penetration of an artery. When the chisel is placed in position, the mallet may then be brought into requisition, being used by the right hand. When the external shell of bone is felt to have given way, it is not advisable to attempt to complete at once this particular portion of the section, because the instrument is apt to be caught. In order to avoid impaction, the entire superficial portion of the section ought to be completed in the first instance, so as to permit a little movement of the instrument in the direction of its breadth; and by making a series of such movements, after each impulse given by the mallet, there can be no fixity. The osteotome or chisel ought not to be pressed against the bone transversely to its breadth, as it is possible that it may be broken or twisted by so doing. The bone itself may be splintered longitudinally by such pressure. In no instance should the osteotome or chisel have a breadth greater than the diameter of the bone about to be cut, otherwise the soft structures at either side are apt to be injured. When a large wedge is to be removed, it is better to do this in several pieces—first a small superficial

wedge, then a shaving of each side until the desired extent is reached. The form of normal bone, as it appears in section, may be of some use in guiding the direction of osseous incisions; but this cannot be absolutely depended on in the case of distorted bones, as their contour is often greatly altered. It may be borne in mind that rachitic bones have a tendency to become flattened, sometimes in one direction, sometimes in another, and that when the bone is curved, the concave portion has the thicker wall as a rule.

OSTEOTOMY FOR THE RELIEF OF ANKYLOSED HIP-JOINT, WHEN AT AN ANGLE PRODUCING DEFORMITY.—In such cases, the neck of the femur is divided so as to enable that bone to be brought down into a straight line with the body. Adams performs his operation with a saw, and thus describes it: 'The left thumb is placed firmly, so as to compress the soft tissues solidly against the bone, at a point situated at the centre of the top of the great trochanter, and the breadth of one finger above. At this point the narrow-bladed knife is pushed in till it reaches the neck of the femur, at a right angle across the front of which it is then carried. The knife is then gently moved to cut a space for the easy insertion of the saw, which, traversing the course of the knife, reaches the front of the neck of the femur and gradually cuts it completely through. The surgeon cuts until he feels that the saw is free of the bone, and moving in the soft tissues only, behind the bone.' The neck of the femur may also be divided by the osteotome, that instrument being introduced at the same place as is indicated above, and with a few blows of the mallet the division is completed. In certain cases, where this operation of division of the neck of the femur cannot be performed on account of the femur being firmly held by cicatricial tissue, or where the muscles and tendons surrounding the joint are much contracted, or where the neck of the femur is altered by absorption or by deposition of bone, Mr. Gant divides the femur immediately below the lesser trochanter. By doing so the limb is restored to the straight position, but is apt to be made somewhat shorter.

OSTEOTOMY FOR ANKYLOSIS OF THE KNEE-JOINT.—When angular ankylosis of the knee-joint is present to such an extent as to render the limb useless for walking, or only permits the toes to reach the floor, the limb may be rendered straight by osteotomy. This operation must not be performed so long as there is any active disease

present in the joint. In this case, the femur may be divided at the same level as for genu valgum; only, the anterior portion of the bone ought to be divided completely over its whole breadth, so as to permit of straightening from behind forwards. If the deformity has assumed nearly that of a right angle, it is possible that this linear osteotomy may not be sufficient to rectify the whole deformity. Under such circumstances, instead of removing a wedge from the femur, it is better to make another linear osteotomy just below the tuberosity of the tibia, or a little to the proximal side of this. When the deformity is great, it is better to have recourse to gradual straightening after the operation, as the sudden strain of complete straightening, on the vessels of the popliteal space, might lead to bad results. The limb may be safely straightened so long as the tibial vessels at the ankle pulsate freely. The straightening ought to be completed during the first week, if possible.

OSTEOTOMIES FOR GENU VALGUM.—Ogston's operation is as follows:—The knee is flexed as fully as possible. A long tenotomy knife is introduced flatly two or three inches above the inner condyle, and pushed downwards, forwards, and outwards, until the point is felt in the intercondyloid space. The cutting edge of the tenotome is then turned downwards, and the soft tissues are divided to the bone as its withdrawal is effected. Adams's saw is then introduced along the groove formed by the knife, and the inner condyle is sawn through, from above downwards, for about three-quarters of its thickness. The fracture is completed by forcibly straightening the limb, the loose condyle slipping upward over the sawn surface. This operation may also be performed by the chisel instead of the saw. Professor Ogston has recently expressed a preference for the operation about to be described.

MACEWEN'S OPERATION FOR GENU VALGUM.—The limb being rendered bloodless, is placed on a sand pillow, where it is securely held by two assistants. One assistant, standing on the opposite side of the table from that of the operator, places his right hand on the thigh, while the other, standing at the foot of the table, places his right hand on the upper part of the tibia. The operator sponges the seat of operation with 1-20 carbolic watery solution; the spray is then directed on the part. A sharp-pointed scalpel is introduced on the inside of the thigh, at a point where the two following lines meet—one drawn

transversely, a finger-breadth above the superior tip of the external condyle, and a longitudinal one drawn half an inch in front of the adductor magnus tendon. The scalpel here penetrates at once to the bone, and a longitudinal incision is made sufficient to admit the largest osteotome and the finger, should the surgeon deem it necessary. Before withdrawing the scalpel, the largest osteotome is slipped by its side until it reaches the bone. The scalpel is withdrawn, and the osteotome, which was introduced longitudinally, is now turned transversely in the direction required for the osseous incision. In turning the osteotome, too much pressure must not be exerted, lest the periosteum be scraped off. It is then convenient to pass the edge of the osteotome over the bone until it reaches the posterior internal border, when the entire cutting edge of the osteotome is applied, and the instrument is made to penetrate from behind forwards, and towards the outer side. After completing the incision in that direction, the osteotome is made to traverse the inner side of the bone, cutting it as it proceeds, until it has divided the uppermost part of the internal border, when it is directed from before backward towards the outer posterior angle of the femur.

In cutting on these lines there is no fear of injuring the femoral artery. The bone may be divided without paying heed to this order of procedure, but it is better that the operator should have a definite plan in his mind, so that he may be certain as to what has been divided and what remains to be done. The writer is persuaded that accidents have happened by not paying heed to this. In using the osteotome, the left hand in which it is grasped ought to give, after each impulse supplied by the mallet, a slight movement to the blade—not transversely to its axis, but longitudinally—so as to prevent any disposition to fixity which it might assume. After the inner portion of the bone is divided, a finer instrument may be slipped over the first, which is then withdrawn; and even a third, if necessary, may take the place of the second when the outer portion of the bone comes to be divided. Whether one or more osteotomes be used depends much on the resistance met with. If the tissue is yielding, one may suffice; if hard or brittle, two or three will effect the division more easily, and with less risk of breaking or splitting the bone longitudinally. In the adult, the dense circumferential layer of bone resists the entrance of the osteotome at the outset, but several strokes cause the instrument

to penetrate this superficial dense portion, when it will pass easily through the cancellated tissue. After a little experience, the surgeon recognises, by touch and sound, when the osteotome meets the hard layer on the outer aspect of the bone. If it be considered desirable to notch or penetrate this outer dense part of the bone, in doing so the osteotome ought to be grasped firmly by the left hand, the inner border of the hand resting on the limb, so as to check instantly any impetus which may be considered too great. It is better to snap or bend this layer rather than cut it. When the instrument is to be altered in position, it ought not to be pulled out in the ordinary way, as it is then liable to be removed from the wound in the soft parts, as well as from the bone. Instead, let the left hand, with its inner border resting on the limb, grasp the instrument, while the thumb is pressed under the ridge afforded by the rounded head, and gently lever the osteotome outwards by an extension movement of the thumb. In this way the movement may be regulated with precision. It is desirable to complete all the work intended by the osteotome before removing it from the wound.

When the operator thinks that the bone has been sufficiently divided, the osteotome is laid aside and a sponge, saturated in 1-40 carbolised watery solution is placed over the wound. While the surgeon holds the sponge he, at the same time, employs that hand as a fulcrum; with the other he grasps the limb lower down, using it as a lever, and jerks, if the bone be hard, or bends slowly, if the bone be soft, in an inward direction, when the bone will snap or bend as the case may be. The limb is then brought into a straight line. A sponge, saturated in 1-40 watery solution, is placed over the wound, and kept in position by a gauze bandage. This is retained until the opposite limb is operated on. After the wound is thus protected, the elastic webbing controlling the circulation is removed, and the limb is held by an assistant, who practises extension meanwhile. After the other limb has been operated on, it is similarly treated while the first is being dressed. Before applying the dressing, any redundant cellular tissue, which may protrude from the wound, ought to be removed by a pair of scissors curved on the flat. The wound is then dressed antiseptically and placed in a special splint. The splint is a modification of the half box, the outer portion being carried up, like a long splint, to about the level of the third or fourth rib, and projecting beyond the posterior splint

at the foot. This projection is fixed in the clamp of a bed-rest, and so the whole limb and splint are kept motionless and steady.

Although osteotomy may be performed without antiseptics, there is an element of risk in so doing. The writer uses strict Listerian precautions in his operations, with the addition of a little iodoform on the inner dressing, when it has to remain on the wound a fortnight or longer. He is further of opinion that, when suppuration ensues after an antiseptic osteotomy, it is almost always due to irritation produced by violence (which is never needed and ought to be avoided), either to the bone or to the soft parts, especially the latter. In cuneiform osteotomies on the tibia, where the wound, both in the soft parts and in the bone, is larger than in linear osteotomies, and consequently more exposed to contamination, the writer has never had suppuration.

WILLIAM MACEWEN.

OSTEOTRITE.—A mill-headed instrument invented by Mr. John Marshall, for smoothing the walls of bony cavities, and for enlarging bony sinuses.

OSTITIS.—Ostitis, or inflammation of bone, is often meant when the word periostitis is used. Inflammation rarely attacks either the periosteum, the compact tissue, or the medulla alone, but clinically the distinction is of value, inasmuch as it indicates the part which is primarily or principally involved. Neither the periosteum nor the medulla is free from inflammation in ostitis, but by the word ostitis the compact tissue of bone is indicated as the primary seat of disease. It most commonly affects the shaft of a long bone, and by preference the tibia or femur.

Causes.—Injuries of various kinds are probably the most common exciting causes of ostitis. Fractures, simple and compound, gunshot wounds, amputations, contusions, burns, and extreme degrees of heat or cold may give rise to it. Injuries of a less serious kind may also be the exciting cause of ostitis, in a subject already inclined to such inflammation. The predisposing causes are syphilis, both hereditary and acquired, struma, and tubercle; both of the latter, however, generally terminate in caries. It also occasionally follows rheumatism and typhoid fever.

Pathology.—In simple ostitis the bone, periosteum, and medulla become more vascular. The Haversian canals enlarge, whilst inflammatory exudation takes place in the connective-tissue around its vessels. The

periosteum is swollen and infiltrated with serum and leucocytes, and is easily separable from the bone, whilst the medullary tissue is similarly engorged. The osseous lamellæ are eroded from absorption, forming Howship's lacunæ, and the notches thus made are filled with embryonic connective tissue. A large number of multi-nucleated cells, called 'osteoclasts,' are found in this tissue, which are supposed to play a not unimportant part in the absorption of bone. In this condition the process is called *rarefying ostitis*, but, coincidentally with this rarefaction, new bone is being formed in the outlying parts beneath the periosteum and in the central canal. The small nucleated cells that take part in this new formation are called 'osteoblasts.' In simple ostitis the two processes are at first constantly going on together. Then, the subsequent changes will vary according to the intensity of the inflammation. Under favourable circumstances the inflammatory new-formation may undergo resolution, and the bone return almost to its natural condition; as a general rule, however, the bone remains somewhat larger from the amount of new material which has been formed around the inflamed area, and becomes, possibly, somewhat denser.

Condensing Ostitis or Osteosclerosis.—As a further development of the same process the ostitis may terminate in osteosclerosis. The inflammatory exudation in the connective tissue surrounding the vessels in the Haversian canals may organise into new bone, and thus fill up the spaces that had been previously formed, and even still further encroach upon these narrow channels till the bone becomes denser and harder than in the normal condition. This condensation may develop to such an extent as to convert the bone into a tissue as hard as ivory. The vessels may even be completely obliterated, as a consequence of the obstruction to the circulation, and the death of a considerable area of bone may in this way take place. The periosteum at the same time develops new bone as is shown under PERIOSTITIS, so that the original bone is increased in size as well as in density. The medullary canal is also encroached upon, and its cavity almost obliterated. This condensing ostitis or osteosclerosis is essentially a very chronic process, and may occur, especially in syphilis, without the preceding stage of rarefying ostitis.

Abscess.—Rarefying ostitis may, also terminate in suppuration, the inflammatory exudation, as in other tissues, forming

granulations and breaking down into pus. This is the ordinary termination of ostitis around a piece of dead bone and in compound fracture. It also not infrequently occurs in simple ostitis of the cancellous tissue, producing the well-known chronic ABSCESS OF BONE which is more fully described under that title. The inflammatory products may also, under certain circumstances, be so quickly formed as to compress the vessels in the Haversian canals and cut off the circulation from a part of the bone, thereby causing its death. The subsequent changes are described under NECROSIS.

Symptoms.—Inflammation of the compact tissue of bone is a chronic affection, beginning slowly and insidiously with obscure dull aching pains, which are worse at night and in wet weather. It may make considerable progress without giving any appreciable sign, except the persistent pain at night, which generally comes on in the evening whilst the patient is sitting over the fire, or getting warm in bed, and keeps him awake for many hours. On examination of the part complained of, it is often found that the bone is already somewhat larger than its fellow, and tender on pressure. As the disease almost always has its seat in the shaft of one of the long bones, especially the femur and tibia, these obscure, persistent, aching pains in any of the limbs should lead to a careful examination of the bone in its whole length. The enlargement will not be absolutely uniform, so that the irregularity can be easily detected by grasping the bone between the finger and thumb, and feeling it in this way from one end to the other. In syphilis, the corresponding bone on the opposite side of the body will be very often found in a similar condition. Tenderness on pressure will vary considerably, according to the sensitiveness of the patient and the stage of the disease. At first it is often well marked, whilst later on it is much less perceptible. There is not often much, if any, swelling of the soft parts, except in the case of wounds and compound fractures. But occasionally, and this chiefly in the tibia, where the bone is superficial, there may be some slight cedema and 'pitting' on careful pressure. Of course in the case of abscess of bone, which, however, does not generally affect the shaft, the condition is different, and will be found described under chronic ABSCESS OF BONE.

Treatment.—Iodide of potassium, in gradually increasing doses, should always be tried. Five, ten, or even fifteen grains may be given three times a day, if the

smaller doses produce no diminution in the severity of the pain. Generally, however, the patient is greatly relieved in quite the early stage by the smaller doses, and this effect is produced in most cases whether the patient be the subject of syphilis or not. In some few instances that have come under the writer's notice, where syphilis was undoubtedly present, the addition of mercury in the form of pil. hydrargyri, gr. v. nightly, has produced a more lasting and permanent improvement, after iodide of potassium alone had failed to accomplish more than a temporary diminution of pain. The application of blisters will also sometimes give relief. Painting with the strongest iodine liniment, or rubbing the affected part with mercurial ointment may be tried, and will occasionally prove serviceable, but iodide of potassium is, as a rule, the most potent remedy where the disease has not become fully established. Unfortunately, in the chronic cases, where the bone has become thickened and enlarged in spite of the treatment employed, nothing can be done to effect a completely successful result. If there be little or no pain, the patient has some inconvenience from the size of the bone and its weight, but he generally learns, in the course of time, to put up with this discomfort. On the other hand, should the pain continue to be a source of serious annoyance, linear osteotomy or the application of the trephine to the most tender spot, will often give the most marked relief. A simple incision through the periosteum is sometimes sufficient, especially in the early stage of the disease, where other less severe measures have failed to effect any improvement. In the later stages, linear osteotomy is probably the best operation, as it gives relief to a larger area of bone than the simple removal of a circular piece by the trephine. The bone should be thoroughly exposed by the knife to the extent of three or four inches, and a groove be cut in it with a chisel or a Hey's saw, till the medullary canal is reached. The bleeding that necessarily ensues relieves the engorged bone, mitigates for a very long time, if it does not entirely remove, the pain, and lessens the chances of subsequent suppuration or necrosis.

H. H. CLUTTON.

OSTITIS DEFORMANS.—Sir James Paget's description of this disease, in the *Medico-Chirurgical Trans.*, vol. ix., 1877, is the first in which the symptoms and history are collected together in a definite form, under the name of ostitis defor-

mans. To him, indeed, we owe the fact that, since the publication of the above paper, one more obscure bone-disease has been reclaimed from the unclassified group of osseous deformities, which still remains in our museums with an incomplete life-history.

Cause.—Nothing whatever is known as to its etiology. Neither syphilis, rheumatism, gout, scrofula, nor tubercle can be said to have a direct influence in this respect, for there is no clear history of these affections running through any considerable proportion of the recorded cases. In three out of the first five cases reported by Sir James Paget, cancer made its appearance late in life. But in seven others, recorded by the same author in vol. lxxv. of the *Medico-Chir. Trans.*, 1882, cancer was not found to be associated with any one of the cases.

Pathology.—It would seem to be a form of chronic inflammation, beginning in old age or after middle life, and affecting principally the long bones and those of the skull. In Sir James Paget's words: 'The bones enlarge and soften, and those bearing weight yield and become unnaturally curved and misshapen.' While increase in size and alteration in shape are the principal external features of the disease, the texture of the bone is not less altered. The normal osseous tissue is replaced by a finely porous substance which, though reticulated and porous, is yet denser than it naturally should be. The strength of this bone is evident, and one can scarcely conceive it possible that bone in this condition could bend, especially when its enormous increase in size is taken into consideration. Such specimens only come under our observation quite late in the course of the disease. It is, therefore, probable that, at an earlier date, the bones atrophy and soften, and then become bent from the weight of the body; and that, subsequently, they undergo those hypertrophic changes which we see so largely developed in the advanced condition of the disease, at which they usually arrive before simple old age or some intercurrent malady terminates the patient's existence.

A splendid specimen of a whole skeleton, obtained by Mr. J. R. Lunn, is described and graphically depicted in *St. Thomas's Hospital Reports*, vol. xiii., 1883. The microscopical appearances, described by Dr. Sharkey, show that the principal feature in the change is one of rarefying ostitis. The complete skeleton, now in the museum of St. Thomas's

Hospital, is quite a unique specimen, and its coarse anatomy is most beautifully shown in the engravings illustrating the paper in the Reports above mentioned.

The *symptoms* are first noticed, as stated above, after middle life or in old age. 'The most characteristic,' according to Sir James Paget, 'are the loss of height, indicated by the low position of the hands when the arms are hanging down; the low stooping, with very round shoulders and the head far forwards with the chin raised, as if to clear the upper edge of the sternum; the chest sunken towards the pelvis, the abdomen pendulous; the curved lower limbs, held apart and usually with one advanced in front of the other, and with both knees slightly bent; the ankles overhung by the legs, and the toes turned out.' The bones forming the vault of the cranium are generally enlarged, and there is frequently a history of larger hats being worn than formerly. The upper part of the spine is bowed and quite fixed in this position, so that, in stooping, no movement can be detected between the spinous processes. The ribs are crowded together and immoveable. The breathing, therefore, becomes entirely diaphragmatic, in a manner exactly similar to the condition which is seen in spondylitis deformans. The difference between the two diseases is, however, sufficiently distinct to make confusion impossible. In spondylitis deformans, the immobility of the spine and ribs is alone observed, combined possibly with general osteo-arthritis. But there is no enlargement or curvature of the long bones, and the skull is entirely unaffected.

On examining the lower limbs in ostitis deformans, the shafts of the long bones will be found very large and unnaturally curved, as if they had at some period of the disease yielded to the weight of the body. Other bones may also be very much enlarged, such as the clavicle, humerus, radius, or ulna, and of these the clavicles are more frequently affected than any of the others. The deformities are generally symmetrical and well-marked.

The patients oftentimes, especially at the commencement of the disease, complain of pain, which is described as rheumatic, in the lower limbs and spine. But, as a rule, there is no pain in the head, even when the skull is considerably enlarged, nor is the mind in any way altered. The general health remains unaffected, and beyond the difficulty in walking and, the breathlessness on any exertion, the disease does not cause any great distress. Life

does not therefore seem to be materially shortened.

Treatment.—There is no indication for any special treatment. Iodide of potassium, useful as it is in some chronic diseases of bone, has been found to be quite powerless to check the progress of the affection, nor does it seem to relieve the pain of which such patients occasionally complain.

H. H. CLUTTON.

OTALGIA.—Ear-ache. See *Circumscribed Inflammation of the External Meatus*, under EAR, EXTERNAL, Diseases of the.

OTITIS. See *Acute Catarrh*, under EAR, MIDDLE, Diseases of the.

OTORRHEA. See *Acute Purulent Catarrh*, under EAR, MIDDLE, Diseases of the.

OVARIAN TUMOURS.—There are several diseased conditions of the ovary which may require the aid of the surgeon, but ovarian tumour is by far the most common, and it is also the most important, because, if left to nature, it leads almost inevitably to a lingering and painful death.

Causes.—But little is known as to the causes which produce ovarian tumour. The position occupied by the ovary; its liability to displacements, which must greatly interfere with both its nerves and blood-vessels; the changes in its position which result from enlargement of the womb, or from improper retention of the contents of the bowel or of the bladder; changes in its tissues which result from the general condition of the blood during the course of the specific fevers; spread of inflammation from the peritoneum, and last, but not least, the changes it undergoes from youth to age, during the formation, maturation, rupture and cicatrization of the Graafian follicles, are all causes predisposing to disease. How it is that some of these conditions induce mere inflammatory changes in the ovary of one person, whilst in another they produce an enormous development of cysts; why these cysts differ so much in their macroscopic and microscopic appearances; and why their place is sometimes taken by a dermoid tumour, and more rarely by a solid fibroma or sarcoma, remain matters of theory and speculation.

Given the predisposing cause, such as change in position affecting the circulation or innervation of the organ; or change in the condition of the blood circulating through the ovary, and it seems very probable that heredity may have much to do with the

result, producing by the same disturbing causes different diseased conditions in different individuals.

Pathology.—Admitting the imperfect knowledge which we possess as to the causation of ovarian tumours, it is not surprising that there is great difference of opinion as to their pathology. The reader who wishes to study this subject, must refer to some of the special works in which the theories are set forth and discussed at length; here we have only space to refer to them very briefly.

Changes in the Graafian follicle are admitted by most observers to be one cause of cyst-formation. Some seem to regard the follicle as almost the sole parent of the various forms of cysts, while others give it a very secondary place, and deny that cysts formed from it ever attain any considerable size. Degenerative changes in the true and false corpora lutea, degenerative changes in the blood-vessels or in the ovarian stroma, the persistence of the rudimentary structures and elements of the foetal ovary, all have their advocates as important factors in ovarian pathology; while some of those who have been most painstaking and laborious in their investigations, believe that the commoner forms of ovarian cystomata are neoplasms of epithelial and glandular formation.

Probably each and all of these various theories have their share of truth. In an organ so remarkable in its structure and development; in its reproductive function; in the vicissitudes due to its situation and surroundings, and in its atrophy and decay; we may be prepared to find a great variety of morbid changes, rather than a repetition of any one process. The examination of a large number of ovaries in early stages of disease, and of a larger number of tumours of considerable size, with a correlative consideration of the clinical history and symptoms of the patients from whom the specimens were taken, has convinced the writer that, while all the processes referred to have their share in the formation of ovarian tumours, change of type in the cells lining the follicles, with invasion of the stroma by the resulting new-formations; colloid degenerations of the stroma, of the walls of the blood-vessels, and of the cicatrices of the corpora lutea; are—somewhat in the order in which they are given—the most common pathological processes at work in the formation of the ovarian cystomata. The more the cells lining the cysts tend to revert to immature epithelial types, and the more the cells forming the stroma of the tumours tend to revert to immature connective-tissue, the

more nearly the tumours approach malignancy. The fact that it is difficult or impossible to say which tumours are malignant and which are not, even when their tissues are submitted to microscopic investigation, should make surgeons very careful how they recommend tapping, or any operative interference short of early and complete removal of the tumour.

The dermoid tumours form about seven per cent. of the cases, and are distinctly of two kinds, benign and malignant; the former being usually associated with some of the other forms of cystic disease, are by far the most common; the latter, of which only a few specimens have been described, are nearly solid, the dermoid structures being mingled in strange confusion with carcinoma or sarcoma. Much has been written about these dermoid ovarian tumours, and the most fantastic theories have been advanced as to their origin, which is, however, probably in no wise different from that of dermoid cysts in other parts of the body, the greater frequency of their occurrence in the ovary being due to two causes—first, the special liability of the organ to originate tumours, and second, the fact that it contains cells which are capable of producing, under certain conditions, all the structures found in the body. The same causes which produce from the ordinary cells cysts or solid growths, produce from the cells which we call ova, more complex structures. The same cells which, under the stimulus imparted by the spermatozoon, produce the perfect individual, under the stimulus imparted by disease produce many or most of the structures which go to form the perfect individual, but in an imperfect form, both as to actual structures and as to their relative arrangement.

Fibromata and sarcomata are occasionally met with, but are rare, and this is not surprising, when we consider that the physiological function of the ovary is the production of cysts (the Graafian follicles). Small fibrous growths are not uncommon in ovaries in an early stage of cystic degeneration, and they appear to arise from proliferation of the cicatricial structures of the corpora lutea, and, probably, the larger specimens occasionally met with have the same origin, the tendency of the individual deciding whether a simple fibroma results from the increased growth of the cicatricial tissue, or whether some one or other of the more malignant sarcomata is produced.

Symptoms.—The early symptoms of the growth of an ovarian tumour, whether

of the cystic or solid kind, are very indefinite, and often there are no symptoms, until the growth has attained a considerable size. In some patients, scantiness of the menstrual flow, amounting, in rare cases, to amenorrhœa, will herald the commencement of disease, and pelvic pains or discomforts will lead to a vaginal examination, when the affected ovary will be found enlarged, and dislocated into the pouch of Douglas. In other cases, increase of the flow at the menstrual periods, and their prolongation, will lead to the discovery of the disease. This is especially the case in elderly women who have passed the menopause; and a return of the catamenia either irregularly or regularly, in such cases, should always lead to a suspicion of some ovarian disease, and to a careful examination of the pelvic organs. This is not sufficiently known, and many patients are made miserable by the fear that such discharge is an indication of uterine cancer, instead of being a symptom of a readily diagnosed and curable disease. Inability to walk without discomfort or pain, constipation, difficult or painful micturition, pain over the ovary, and pain or numbness in the leg on the affected side are also among the commoner symptoms, while the increase in the size of the affected ovary is still so slight that it can only be detected by the most careful bi-manual examination.

Diagnosis.—In this early stage, differential diagnosis will have to be made between organic disease of the ovary and mere enlargement due to congestion or inflammation, and it is usually quite impossible to make a certain diagnosis. Fortunately, it is not necessary for the surgeon to interfere thus early, and simple soothing treatment is equally good for either condition, and will often clear up the doubt; mere congestion or inflammation yielding to such treatment, and the ovary returning to its proper size and place.

When an ovarian tumour becomes sufficiently large to fill the pelvic cavity or rise into the abdomen, the symptoms which are present in its earlier stages usually disappear, and the time has arrived when the surgeon is called upon to make an accurate diagnosis, and decide whether the tumour shall be removed. While the tumour is still in the pelvis, it is often extremely difficult to diagnose with certainty between ovarian tumour, fibro-myoma of the uterus (especially the sub-peritoneal and pediculate forms), collections of serum, pus, or blood in the Fallopian tubes, extra-uterine foetation, serous effusion into the cellular tissue,

hæmatocele, pelvic abscess, or some of the rarer forms of pelvic tumour. The history of the case, especially as to menstrual irregularities and variations of pulse and temperature, must be carefully inquired into, without, however, giving it undue weight; for nothing is more misleading than the history of symptoms given by a stupid or unobservant patient. If the tumour be mobile, fairly separable from the uterus, the catamenia regular, and the patient free from febrile disturbance, the case is probably either ovarian or pediculate fibro-myoma, and a little patience, while watching the rate of growth and any variations in the consistence of the tumour at different times, will soon enable the surgeon to decide between them. If the tumour is fixed, and there has been fever, it is often much more difficult to decide; an experienced touch will rarely, however, in such a case have difficulty in excluding pelvic cellulitis, abscess, or hæmatocele, for in each of these there is a gradual shading off from the tumour to the surrounding tissues, and a fixing of the other contents of the pelvis, which is very different from the mere fixing by peritoneal adhesion of a tense cyst or of an elastic solid growth. The history of cellulitis, abscess, and hæmatocele is usually sufficiently marked to confirm the opinion formed by touch.

The diagnosis of the various forms of distension of the Fallopian tubes is a matter of much greater difficulty, and cases are met with in which both tubes are greatly distended with pus, forming considerable tumours, and even rising high up into the abdomen, in which absolutely no serious symptoms have been observed, either by patient or medical attendant, till the tumours have been detected by their size. In such rare cases there is no choice but to wait for further development of the tumour, or to make an exploratory operation, and as each case must be decided on its merits, it is useless to attempt to give general rules. It is necessary, however, to remember how grave may be the risk of waiting too long in a case of tubal pregnancy, of large pyo-salpinx, of pelvic abscess, or of suppuration in the uterine wall; the latter a very rare condition, but one that is occasionally met with.

When the tumour has attained considerable size, and occupies a large portion or the whole of the abdomen, the differential diagnosis may still have to be made from some of the conditions named above, such as large abscess or hæmatocele, and extra-uterine foetation, or other form of tubal cyst;

and a large number of other diseases must also be added to the list of those which may be mistaken for ovarian tumour. Solid tumours of the ovary are still more difficult to distinguish from uterine outgrowths (fibro-myomata), and some of the large soft uterine tumours give an elastic impulse so like fluctuation, that the most experienced surgeon may be deceived by it, and may mistake such a tumour for an ovarian cyst. A careful use of the uterine sound, while an assistant moves the abdominal tumour, will usually clear up the doubt, except in cases in which the uterine body is so closely adherent to, and incorporated with, an ovarian cyst, that the latter is practically a uterine tumour. In such cases an exploratory incision can alone decide.

It is rarely difficult to distinguish between ascites and cyst, but in cases in which the latter has ruptured, or has discharged much of its contents into the peritoneum through a tapping puncture, the diagnosis is difficult. In such cases it is sometimes advisable to draw off the peritoneal fluid by aspiration or tapping, and then the tumour, if present, is more easily handled and diagnosed. In ordinary cases the position of the dull area, and a careful observation as to whether the fluctuation wave extends beyond it, will decide between free and encysted fluid, but all sorts of exceptions to these general rules are met with. For example, a flaccid, broad ligament cyst will often very closely simulate ascites, the position of the dullness following the changes of position on the part of the patient; so also a cyst with its borders overlapped by adherent intestine, may readily be mistaken for free fluid, or for peritoneal fluid partially encysted. The rule usually given as to the dullness in ovarian dropsy being more to the one side than the other is, in the majority of cases, fallacious; comparatively small tumours frequently occupying a central position. In deciding whether fluid be free in the peritoneum or in a cyst, the most important point to note is, whether the line of dull percussion and the limit of fluctuation exactly correspond; if they do it is nearly certain that it is in a cyst, and changing the position of the patient, without varying the relation of the dull and clear areas, will confirm the diagnosis.

The best way to arrive at a diagnosis in a case of abdominal tumour, is to place the patient on the back with the head and shoulders well supported by pillows, the hands laid at rest on the shoulders, and the knees raised. The abdomen should then be thoroughly exposed, and the patient made to

breathe through the mouth, the lips and teeth being kept well apart. This relaxes the muscles and enables the surgeon to tell at once, by palpation, where it is soft and natural. The healthy parts should first be thoroughly palpated and percussed, because in passing from the normal to the abnormal, a correct impression of the disease is much more likely to be obtained than by the reverse process. Having carefully mapped out the abnormal structure, and noted its relations to the surrounding and healthy parts, the patient's position should be changed in various directions, and the same process repeated in each. During this procedure, anyone with experience will probably have made up his mind as to the nature of the tumour; but it will be well nevertheless to continue the investigation by excluding the possible growths one after another, till the one he has diagnosed is reached. It is undoubtedly true that the first and rapidly formed diagnosis of an experienced surgeon is often the most correct; but nothing is ever lost by care, and serious error is frequently avoided.

In deciding that a tumour is ovarian, ascites of various kinds, phantom tumours, obesity, malignant or simple enlargements of the liver; distension or tumour of the gall-bladder, solid enlargements and cystic tumours of the spleen; tumours of the omentum and mesentery, sub-peritoneal cysts; distensions, cysts, or solid tumours of the kidney, distension of the ureters, distension of the bladder; hydatids of liver, spleen, kidney, omentum, mesentery, or parietal peritoneum; accumulations (for instance, hair) in the stomach; fecal accumulations in the bowel; the various forms of extra-uterine pregnancy, hydramnios, accumulations in the Fallopian tubes, fibrocysts, and solid fibro-myomata of the uterus; peritoneal and retro-peritoneal hæmatocoele, pelvic abscess, abscess of the ovary or of the uterine wall, cysts in connection with the spinal cord; and last, but not least, ordinary pregnancy, should each and all be passed rapidly through the mind. Of course the experienced surgeon will do this almost by intuition, without the onlooker noting the steps of the process; but the student, and the practitioner who has but few opportunities for examining such cases, will make fewest mistakes and learn most, who spends some time and care over a diagnosis *by exclusion*. Even the most experienced would often save themselves from discreditable mistakes, and their patients from serious calamities, by a little more method in their examinations. All said and done,

there will still be cases of abdominal tumour which will defy the ingenuity of the most skilful, and only be certainly diagnosed by exploratory incision.

Treatment: aspiration or tapping.—Before passing to the operation for the radical cure of ovarian tumour, it is necessary to say a few words about aspiration and tapping. It is occasionally advisable to perform one or other of these operations and remove fluid from the peritoneum, in order to give temporary relief to lungs, heart, or kidneys, or to enable an abdominal tumour which is surrounded by fluid to be more accurately examined. The chemical and microscopical examination of the fluids thus obtained may throw important light upon their source, but these examinations, even by experts, cannot be trusted to alone for the formation of a diagnosis, but must be carefully compared with the symptoms and physical signs present in the case.

It has long been the fashion to advise one or more tapplings in ovarian tumour or dropsy, and to claim it as a curative operation in parovarian and broad ligament cysts; there are, however, immediate dangers attending this apparently trifling operation, and a more extensive knowledge of the nature of ovarian cysts and their contents shows that the more remote dangers are still more to be dreaded. Among the former are fatal hæmorrhage into the cyst, acute peritonitis from escape of unhealthy cyst-contents into the peritoneum; inflammation and suppuration of the cyst-wall and serious adhesions to other organs; among the latter, the growth of malignant disease in the parietes or peritoneum at the tapping puncture, or its still wider diffusion over the peritoneal surfaces. The apparently simple cysts are as likely to cause these latter disasters as those in which the malignant elements are more clearly discernible, and the parovarian and broad ligament cysts are very often the seat of a form of papilloma, which, with opportunity, readily diffuses itself over the peritoneum. When it is considered that tapping cannot cure an ovarian cyst, and but rarely cures any other, and that it exposes the patient to all these dangers, it must be admitted that the surgeon best consults his patient's well-being and his own reputation, who resolutely refuses either to tap or sanction the tapping of these cysts. As tapping of the peritoneum is not only justifiable but advisable in certain cases, and as tapping of an ovarian or broad ligament cyst may occasionally be necessary, in consequence of special complications, or of the obstinate

refusal of the patient to submit to the major operation, it may be well to say a few words about it.

If the surgeon tap with 'Listerian' precautions—and no wise man will perform the operation without them—the patient should be laid on her side with the abdomen overhanging the edge of the bed, and protected by towels or india-rubber sheeting from chilling and wetting by the spray. Then, if the fluid be in the peritoneum, a lancet should be pushed boldly through the linea alba, and a conical and blunt-ended trocar, with holes at the sides, rapidly introduced through the puncture as the lancet is withdrawn; if a cyst is to be tapped, the lancet puncture should only penetrate the skin, and a sharp-ended trocar, such as Thompson's, should be used for the cyst, as it is less liable than the lancet to wound any large vessel in the cyst-wall. When the peritoneum or cyst is empty, the trocar should be quickly withdrawn, while the finger and thumb of the left hand compress the point of puncture and prevent the entrance of air; a small pad of antiseptic dressing should then be placed over it, and a larger piece of adhesive plaster, and the patient turned on to her back, and the abdomen supported by a flannel bandage or soft towel, secured by a few safety-pins. The patient should be kept on her back for twenty-four hours, or longer in the case of a cyst, to avoid weeping from the puncture. No squeezing or pressure on the parietes should ever be allowed during tapping, or air in large quantities may be sucked in. It is quite needless to apply a sheet or a many-tailed bandage round the patient during the evacuation of the fluid if the side posture, with the head and shoulders nearly on a level with the body, be adopted. In such antiseptic tapping a good-sized trocar, from a quarter to half an inch in diameter without any tubing on it, may be used, and the canula can readily be cleared by a probe if necessary, and the entrance of a little air disregarded. If, however, antiseptic measures are not adopted, it will be safer to use the aspirator, with the finest needle that will evacuate the fluid, and the greatest care to exclude air. Even in this case the needles should be carefully oiled with carbolic oil, or other antiseptic, as the most rapidly fatal septicæmia has been known to follow the use of a dirty trocar in tapping an ovarian cyst.

J. KNOWSLEY THORNTON.

OVARIOTOMY.—The operation for the removal of an ovarian tumour has

been, from its early days, termed Ovariectomy, and though Oöphorectomy would have been a more correct description of the procedure, the old term has become so famous that it can never be discarded; and Oöphorectomy has now become thoroughly associated with a different class of operations, which have been described in so far as they differ from Ovariectomy.

Preparation of the Patient.—It is essential that the bowels should be acting regularly and well, and that the secretion of urine be free. To ensure this, mild aperients should be given for a few days before operation, and fifteen grains of citrate of potash well diluted three times a day. It is rarely necessary to restrict or alter the diet, but patients are better altogether without, or with very little, stimulant, and with red meat only once a day for some time previously. If the operation be in the morning, at nine or ten o'clock, the bowels should be well cleared over night by a simple enema, and at about five or six the patient should have a good breakfast-cup of strong beef-tea or soup, and nothing more before the operation. If the operation is to be in the afternoon, the enema should be given either before breakfast or a couple of hours before the operation, and the patient should have a light breakfast at the usual hour, and the cup of beef-tea about noon. Whether the patient has passed water or not, the catheter should be passed immediately before the operation. The best dress is the ordinary night-dress, with a short flannel jacket, and stockings on. The room where the operation is to be performed should be arranged while the patient is in another, and the instruments should be covered up, so that she does not see them when she comes in. It is far better for her to walk quietly into the room and lie down on the operating table before the anæsthetic is given; but only the surgeon, the anæsthetist, and the nurse should be present till she is unconscious. This plan not only saves time, but avoids the necessity for carrying the patient from the bed to the table during narcotism, which is always objectionable, and especially so in cases with a greatly distended abdomen, and impeded circulation and respiration.

The particular anæsthetic must be left to the taste of the individual surgeon. Chloroform, given by a Junker's inhaler, answers well in most cases.

Preparation of the Room, Instruments. Sponges, &c.—The room should be light, airy, and quiet, and should be thoroughly cleaned the day before, and all dust should be wiped away with a damp cloth, but there

is no necessity to remove carpets, curtains, &c., and make it bare and cheerless.

The patient should be laid on her back, the head and shoulders well supported by an inclined plane of pillows, and the feet towards the window. The table should be long enough to hold her comfortably, not too wide—about 2 feet, and high enough to avoid much stooping on the part of the operator. When a single ordinary table is not at hand, two light deal dressing-tables answer very well, the lower one placed slantways across the window, and the upper one across its upper end, so that the two form the letter L placed upside down towards the window. The legs of the tables should be tied together to prevent their slipping apart, and the patient, when nearly unconscious, should be secured to them by a broad strap firmly fastened just above the knees, and by soft leather wristlets with a connecting strap under the table. In the window stands a small oblong table large enough to hold the spray-producer, the instrument-trays, and the dressings.

The operator stands on the right side of the patient, with his right hand within easy reach of this table, so that he can take up each instrument quickly as he requires it; this is much better than trusting to an assistant or nurse to hand things, for no two brains can work like one, and it is often important to take the right thing without loss of time. The chief assistant stands opposite to the operator, and, at his right hand, on the projecting upper part of the operating-table, is placed a large basin full of warm 1-40 carbolic lotion with the clean sponges in it. The nurse stands beside this basin, and squeezes out the sponges as they are wanted. No towel should ever be used for this purpose, and the sponge should touch nothing but the hands after it leaves the lotion. The anæsthetist stands at the patient's head, and if another assistant is wanted (which is rarely the case) he stands at the operator's left hand. The operator should have a basin of warm 1-40 lotion, with a sponge in it, near him on a chair. The spray bottle should be filled with 1-20 lotion, the instrument trays with warm 1-40 lotion, so that all the instruments are well covered. Ordinary tin pudding-trays, 14 inches long by 6 inches wide, and 2 inches deep, will be found most convenient. Two of these will hold all the instruments necessary for the most complicated abdominal section. The instruments should all be arranged each in its own place in the trays, and the lotion poured over them half an hour before the

operation begins. The silks used for ligatures and sutures should be soaked in 1-20 lotion for at least an hour before use. The nurse who stands by the sponge-basin holds an empty basin for the dirty sponges, takes them and washes them well in a large footpan of warm water, and then replaces them in the 1-40 lotion, from which she or the assistant squeezes them, and hands them to the operator.

The preparation of the sponges is very important. New sponges require much knocking or beating in a pillow-case while dry, and many washings in warm water, or in water slightly acidulated with hydrochloric acid to get rid of the sand. They are then dried, and, if no sand can be knocked out of them, they are placed in 1-20 carbolic lotion for twenty-four hours. After they have been used, they are washed in warm water with common washing soda, to remove all blood and grease, then several times in plain warm water, then in 1-10 solution of sulphurous acid; this whitens, softens, and disinfects them, and after being well wrung out of it they are ready for use. They should be placed in the warm 1-40 lotion from which they are used, at least half an hour before the operation.

The abdomen of the patient should be well washed with warm 1-40 lotion by the nurse before she comes into the room, and covered with a moist napkin wrung out of the lotion; this is covered with a piece of mackintosh, and kept in its place by the flannel bandage to be used after the operation, pinned with three safety-pins. This flannel bandage is made of fine flannel lined with soft calico, the latter sewn over the edges all round, so that the flannel does not touch and irritate the skin. It is used all through the progress of the case, to keep the dressings in place, and give the parietes firm support.

When the patient is unconscious, a large piece of mackintosh, with an oval window cut in it, the edges of the opening smeared round with carbolised adhesive plaster, is applied to the abdomen. This apron should be large enough to cover the whole patient, and keep everything clean and dry. The abdomen and outer surface of the apron, the hands and arms of the operator and assistants, are well wetted with 1-40 lotion, without any after-drying, and the spray is turned on.

The instruments necessary for an ovariectomy of average difficulty are: two sharp, straight bistouries, and one with a probe point, a director, Adams's eye-hook, a pair of ordinary artery catch-forceps, twelve or

more pairs of Wells's small pressure-forceps, a vulsellum, two pairs of Nélaton's cyst-forceps, a long-bladed temporary clamp, two curved perineum needles in handles, one long straight needle (five or six inches long), a pair of smooth-ended uterine polypus-forceps for passing the sponges into the pelvis, flanks, &c., a pair of blunt-ended scissors curved on the flat, a scissors-handled needle-holder and twenty straight needles threaded in pairs on No. 1 silk, eighteen inches long, for the abdominal sutures, and a large cyst-trocar; also No. 0 or 1 Chinese silk for fine ligatures, and No. 3 for tying the pedicle; these should be wound on reels, and should have been in soak in 1-20 phenol lotion for at least an hour.

Each instrument, as it is used, is taken out of the solution in the trays, and replaced in them when it is done with, or till it is wanted again. It is a common thing to see bloody instruments laid about on blankets, towels, &c., quite out of range of the spray, then taken up and used again without washing in the lotion, and the operator is indignant if he is told that he is careless, and is surprised if his case does not run an aseptic course.

Operation.—The incision through the skin and the abdominal wall, down to the fat over the peritoneum, should be made rapidly with a few bold sweeps of the knife; then, the assistant sponging the wound, each bleeding point is secured by a pair of pressure-forceps. The peritoneum is then to be opened, and this is easy enough in an ordinary case, as the tumour can be seen through it; but where there is adhesion more care is required, or the cyst-wall may be incised, or omentum, intestine, or bladder injured. For picking up a delicate peritoneum Adams's eye-hook will be found very useful, and it is a far safer instrument to use for this purpose than the ordinary artery-forceps, which is often employed, as with it the omentum or intestine is very likely to be picked up and incised along with the peritoneum. As soon as the peritoneum is opened to the extent of the external incision, the cyst should be tapped and emptied. Frequently the adhesions are first separated, but this is bad practice, because if they are separated while the parietes and cyst-wall are both stretched by the fluid, all the little vessels in them bleed, and very serious hæmorrhage may occur out of sight during the subsequent emptying of the cyst; whereas if the cyst be first tapped, the contraction of both parietes and cyst-wall closes the smaller vessels. Moreover, the cyst, when flaccid,

can be separated from adhesions bit by bit, each vessel being secured by temporary pressure-forceps or by permanent ligature, as it is torn or cut. If there are more cysts than one to empty, the trocar may be pushed on from the first into the others till they are all emptied, but great care must be taken not to push it through the cyst-wall against intestine. When the tumour is more solid, the trocar should be removed, its hole of entry enlarged, and the hand introduced to break down the septa.

As soon as the tumour is sufficiently reduced in size by one or other process, the operator should explore the peritoneum round it with his hand, to see if there are adhesions, and to learn the seat and character of the pedicle. Before doing this, he should carefully wash his hands in the basin of lotion by his side; for, if his hand has been in the cyst, he may carry cells into the peritoneum, which will set up new growths there. The frequent washing of the hands during an operation of this kind is also important, to avoid the introduction of blood, &c., into the recesses of the peritoneum. If there are no adhesions, the cyst should be slowly and carefully extracted till it is all outside, and the pedicle fully exposed, its place in the abdomen being taken by a large, flat, soft sponge, freshly wrung out of the warm lotion.

The operator now grasps the pedicle between the left thumb and forefinger, gathering in his grasp all the large veins in its outer part, but avoiding the Fallopian tube; manipulating the pedicle between the nails of the finger and thumb till he gets a small spot clear of any vessel, he transfixes with an ordinary, fine, short, straight needle, threaded with a single No. 3 Chinese twist ligature, and with this ties all the veins (pampiniform plexus) in the outer part of the pedicle. If the patient be young and full-blooded, it is well to pause a few minutes and let the arterial blood go on pumping into the cyst till it is well injected; this is a neat and cleanly way of bleeding the patient if it seem advisable. If, on the other hand, the patient be already very weak and anæmic, this *outer-edge* ligature should be applied last. The *outer-edge* ligature being tied, another non-vascular spot in the pedicle is manipulated between the finger and thumb, and through it a long-handled, curved perineum-needle, armed with a double No. 3 ligature, is passed, the outer loop is tied in the groove formed by the *outer-edge* ligature, but includes a greater thickness of the pedicle; care being taken that the ligatures interlock, the inner

loop is then also tied, and it includes the Fallopian tube and the chief arteries. In broad, thick pedicles, two or three such transfixions may be necessary, and in this case one loop should be tied, then the untied ligature is re-threaded into the needle together with a third silk, and they are passed through the pedicle; the second loop of the first transfixion is then tied, care being taken that it locks with the last silk which was introduced with it, and thus a perfect chain is formed, and slipping of ligatures is impossible, while bleeding from the transfixion punctures is also prevented. The pedicle on the distal side of the ligatures is now seized on its inner and outer borders with a couple of pairs of pressure-forceps, and the tumour is cut away about three-quarters of an inch from them; a shorter stump is not safe, and a longer one being imperfectly nourished is likely to lead to trouble, such as adhesion to intestine, &c., or even to inflame and suppurate or slough.

After the tumour is cut away, the assistant holds up the stump by the two pairs of forceps, and a separate No. 3 ligature is tied round the whole for greater security. These pure silk ligatures absorb more slowly, but as perfectly, and with quite as little irritation as catgut. If the operator prefer to use the actual cautery, the tumour should be held up by the assistant, while Baker Brown's cautery-clamp, with the ivory non-conductors downwards, is applied and firmly screwed up; the tumour is then cut away, leaving a good inch of tissue outside the blades of the clamp. This stump is then slowly burnt away with the cautery-irons at a very dull red heat; when it is burnt off level with the blades they are unscrewed and slowly opened, and if sufficient time and care have been taken, the part between the blades will be found in its whole thickness decolorised and translucent, like a piece of horn; if any points bleed the clamp must be screwed up, and the irons reapplied, or it may be necessary occasionally to ligature a vessel or two. When released from the clamp, the stump should be allowed to drop quietly back into the pelvis, and care should be taken not to disturb it in any after sponging which may be necessary. The cautery needs more time and care than the ligature, is not nearly so universally applicable, and requires greater experience in its use; but, where it can be used, results are excellent, and as a theoretical method it is certainly perfect. It should never be used after ligature by the ordinary method, as it destroys the vitality

of the distal part of the stump, and may lead to sloughing. No directions need be given for applying the clamp, as that is a clumsy contrivance which has deservedly passed into obscurity.

Cases are met with in which the base of the tumour is so situated between the layers of the broad ligament, or so pushes its way under the peritoneal covering of the uterus, or of the pelvic floor, that cautery and ligatures are alike inapplicable, or at least ligatures can only be applied after much previous enucleation. When this is the case, an incision should be made through the peritoneal capsule of the tumour, and careful enucleation practised with the fingers. It is well, if possible, so to direct this process as to isolate, at an early stage, the parts of the broad ligament which would form the pedicle in an ordinary case, and then to transfix and tie them in the usual way. After this the chief blood-supply of the tumour is under control, and the rest of the enucleation may be more rapidly and boldly made. Shreds of capsule which bleed should all be secured temporarily in pressure-forceps, and ligatured with or without transfixion, after the tumour is completely shelled out. Usually, the capsule falls together and no oozing occurs, but sometimes this is troublesome from a large surface, and Paquelin's cautery, or solid perchloride of iron, may be applied. The latter is, on the whole, the most satisfactory, if applied with the precautions to be given hereafter in describing its use for oozing from adhesions.

In performing these enucleations, the operator must always bear in mind the fact that the capsule is often the pelvic parietal peritoneum, and that he is consequently brought into dangerously close relations with bladder and ureters, rectum and sigmoid flexure, or cæcum and appendix vermiformis (the latter is very frequently adherent in these cases, and, as it bleeds very much when torn, requires careful handling, and often repair with a fine needle and silk). The large iliac vessels are also occasionally incorporated with the capsule.

When much enucleation is required, it will be necessary to have many more pairs of the small pressure-forceps in the trays, and two pairs of Wells's large curved pressure-forceps, two pairs of the same straight, and a few pairs of the square or T-shaped forceps introduced by the writer, will be found very useful. The above instruments, together with assorted sizes of Keith's glass drainage-tubes, with pure rubber sheet for

fixing over them, and a Wells' tapping trocar or a small aspirator, and some No. 4 Chinese silk ready soaked, should always be at hand for a specially difficult case.

If there are extensive adhesions to parietes, omentum, mesentery, intestine, or other viscera in the case of an ordinary pediculate cyst, it is better to separate them bit by bit as the cyst is extracted, applying pressure-forceps to the bleeding points, and protecting omentum or bowel by towels wrung out of warm lotion. Then, after the tumour is entirely removed, the adhesions can be dealt with. In some few cases this method may be advantageously departed from, and the pedicle ligatured in two places and divided between the ligatures, before the adhesions are separated.

Adhesion to bowel or other viscus, which is so firm that it cannot be separated without tearing, should be treated by cutting a piece of the tumour out, and leaving it adherent till the rest of the operation is completed; when it should be carefully scraped and pared down as closely as possible, in order to leave nothing but the peritoneal and fibrous coat, and to avoid epithelial new-growth.

In some rare cases, it will also simplify the extraction of the cyst if it be seized from within and turned inside out; but the cases in which these special manoeuvres are useful can only be learnt by practice.

As soon as the pedicle is secured, the pouch of Douglas and anterior *cul-de-sac* should be sponged out, and the flat sponge changed for a clean one. The adhesions should then be dealt with. If there be much torn omentum, which has been adherent to the tumour, it is well to secure the whole of it by a chain of fine silk ligatures some little distance above the torn parts, and cut all away; this saves time, and omentum which has been closely adherent is very likely to be infected by cell-growth from the tumour, and is better removed, as it may be the seat of recurrence of a malignant growth. The bleeding points in the parietal peritoneum should be secured with fine silk ligatures, applied, as far as possible, with a fine needle passed under the mouth of the vessel; oozing surfaces may be touched over with the cautery (Paquelin's), or with perchloride of iron. If the latter be used, the surfaces to be touched should be dried with a sponge, then a small sponge, well wrung, should be smeared lightly with the solid perchloride, and firmly pressed against the oozing surfaces till the oozing stops; a large, flat sponge should be spread under

the surfaces thus treated, to prevent any of the acid serum, which runs away immediately after the application of the iron, getting on to the intestines. Oozing surfaces in the pelvis are treated in the same way, the intestines being first drawn out of the way and protected by sponges. Sometimes, tincture of iodine will answer, but its action is not so powerful as that of the iron. Mesenteric and intestinal adhesions should be secured by transfixion with fine silk, and sometimes a bleeding surface may be treated by running a fine silk in and out through the peritoneal coat, and tying it up like a bag's mouth. If the intestine or bladder be wounded, the wound should be sewn up by a fine, continuous silk suture, introduced through the peritoneal coat so as to invert the peritoneal edges. When all bleeding has ceased, the peritoneum should be again carefully sponged out, special care being taken to cleanse the pelvis, the anterior *cul-de-sac*, and the loin pouches. The pedicle is then drawn up and examined, and the forceps which were placed on it just before the tumour was cut away, are removed.

The flat sponge being still in, the sutures are introduced, straight needles about two and a half inches long, threaded at each end of a No. 1 Chinese twist ligature eighteen inches long, being used, and introduced from within outwards with the aid of the needle-holder. Each needle is passed just through the edge of the peritoneum, and then carefully through all the various structures forming the abdominal wall, and out through the skin about a quarter of an inch from the edges of the incision. The sutures should be introduced a little more than half an inch apart, the top and bottom sutures taking up the angles of the incision in the peritoneum. When the sutures are all in place, a small sponge is passed into the pelvis beside the pedicle, and, if it comes out dry and clean, the flat sponge is withdrawn, and the sponges and small pressure-forceps are carefully counted. The number of forceps and sponges in use should always be known, both by operator and nurse, before the operation, and no sponge should ever be torn by anyone during its progress.

In tying the sutures, great care should be taken to bring the skin edges accurately together, and they should not be tied too tightly, or a thin and puckered cicatrix will result, and the danger of ventral hernia from a weak scar be increased. A pad of carbolic gauze, six or eight layers thick, and large enough to overlap the edges of the incision an inch all round, is now

applied, the surface next the wound being first wetted with the lotion; over this two or three similar larger pads, and then one with a piece of pink mackintosh under its outer layer; this outer dressing should not be broader than four inches, and long enough to overlap the top and bottom of the wound by about two inches. Straps of adhesive plaster are then applied over the whole abdomen; they should be from one and a half to two and a half inches broad, and long enough to support both loins well. If the abdomen has been greatly distended, cotton-wool pads are applied over the dressing but under the strapping, to fill up the hollows and give firm elastic support. A folded towel is applied outside the plaster to overlap the lower edge of the dressing, and form a firm support to the wound, and over this the flannel bandage, already described, is pinned. The patient is then carefully lifted into bed and laid on her back, the head and shoulders well supported by an inclined plane of pillows, and a good firm pillow placed under the knees. The bed should be guarded across the centre by mackintosh and a many-fold draw-sheet.

After-treatment.—The temperature is taken in the vagina, and the pulse noted; as soon as the patient rouses up and begins to feel pain, twenty drops of laudanum in an ounce of water are injected into the rectum, and this injection is repeated two, or perhaps three, times in the first few hours. If the weather be cold, a hot bottle is placed at the feet. The patient should be lightly but warmly covered, a single blanket next the night-dress, then the sheet, and two, three, or more blankets over this according to the season. For the first twenty-four hours or more, if there is sickness, nothing is given by the mouth but little pieces of ice, or a teaspoonful of tepid water, or plain soda-water. About six hours after the operation, or sooner if the patient be very weak, three ounces of strong beef-tea are injected into the rectum. The beef-tea should be made without salt, and injected just warm enough to be liquid. This injection is, in ordinary cases, repeated every three hours (every two if the patient be very weak), and every six hours twenty drops of laudanum are added. Before each injection, the female pipe of a Higginson's syringe is placed in the rectum, with the bottom of an ordinary soap-dish under it, so that the flatus and refuse may pass away; it remains in ten minutes, and then the fresh injection is given. The injections are continued in this way for the first few days, and gradually stopped as the

patient begins to take sufficient nourishment by the mouth.

When all chance of sickness is over, a little milk and soda-water (equal parts) is given each hour, then a little bread and milk; then, if these are well borne, a little clear beef-jelly with bread, and about the third or fourth day a cup of weak tea, with bread and butter, night and morning, and a little boiled sole for dinner. Then, gradually, chicken, minced chop, &c., &c. If sickness or retching is troublesome, a tumbler of water, as hot as it can be drunk, sometimes with the addition of a teaspoonful of sal volatile, should be given. If there be peritonitis, with bilious or dark vomiting in quantity, a long red rubber rectum-tube should be passed into the stomach, and a thorough washing out with warm water, or warm water slightly carbolicised, made at intervals of from six to twelve hours, till the fluid ceases to accumulate. Liquid nourishment and stimulants, if necessary, may be given between the washings out, and much will be absorbed till the stomach begins to distend again. In some cases, large quantities of dark green, purple, or black fluid can be got rid of in this way, and a patient's life saved. In ordinary cases, the temperature rarely rises above or even to 101° F.; but if it should rise much above this, especially if the pulse quicken also, some pounded ice, tied up in a piece of mackintosh, should be kept on the head till the temperature falls to normal. If more severe hyperpyrexia is present, the india-rubber coil ice-water cap should be applied. In either case, when once used, ice should not be taken on and off, or serious brain-mischief may be induced. Ice should never be put on after the operation, till the skin is acting well.

Rapid rise of temperature before the skin acts is rarely of consequence, but if it continue with a freely acting skin, it should be checked. In very rare and extreme cases even the ice-water cap is not sufficient, and it will be necessary to pack the limbs or the whole body, except the abdomen, in cold, wet sheets. If the cold pack is applied, the arms should first be wrapped in wet towels, then iced water should be squeezed over them from a sponge as they dry, and if the temperature still rises, the legs, and, if necessary, the trunk, should be treated in the same way. The temperature should be taken at least every hour in the vagina in these cases, as the cold sometimes causes great and sudden depression. If there be any trouble in the downward passage of the flatus, or any threatening of intestinal ob-

struction, a mixture of *Liq. morph. hydrochloratis* ℥x. and *Liq. atropiæ* ℥ij. in a teaspoonful of water, should be given every three or four hours till the distension is relieved.

If the refuse from the rectal feeding be offensive, or if too much comes away, a couple of grains of quinine, in a dessert-spoonful or table-spoonful of port wine, should be added to each injection. Septic mischief may result from the retention of a quantity of putrid beef-tea in a rectum which has become sore and irritable.

In all ordinary cases, the dressing should remain undisturbed for a week or eight days; it should then be taken off, the wound moistened with warm 1-40 lotion, and all the sutures be removed. A smaller gauze dressing, with the same method of strapping, is then re-applied for another week, at the end of which time the wound will be found firmly healed, if care has been taken in approximating the skin-edges. Straps, six inches long, are then all that is necessary, and these should be changed every week or ten days by the patient after her return home, for at least two months, to secure a thoroughly firm, linear cicatrix, and avoid all chance of ventral hernia.

The catheter is generally necessary for the first few days, and with some patients till the bowels have acted, or till they can sit up. Some patients will pass their urine almost from the first. The nurses should be made to use silver catheters with a stilette, and to keep them scrupulously clean, and also in cases in which there is any vaginal discharge, to sponge with a little weak carbolic lotion before passing the catheter. Almost all fresh nurses produce cystitis by clumsy use of the catheter, and it is a great misery to the patient, often leaving an irritable bladder for weeks after everything else is well.

The bowels will usually remain quiet for a week, but may be moved a day or two earlier in some cases. The nurse should pass her finger into the rectum as soon as the patient feels any uneasiness, and if there are hard feces, she should inject 4 oz. of warm olive oil, leave it in for four or five hours, and then give a simple water, or soap and water, enema of a pint and a half; it is better to give two or three small enemata till the bowel is clear, than to over-distend it at first. After the bowels have been once cleared, an enema should be given every second morning till they act of themselves.

The patient should have a good fitting elastic abdominal belt, and this should be

put on at the end of the fortnight, after the second dressing, when she may be allowed to get on to the couch. Hospital patients are generally quite well enough to go to a convalescent home from the eighteenth to the twenty-fourth day after operation. Sometimes, convalescence is retarded by phlegmasia or thrombosis, just when they first begin to move about. This is often a cause of a good deal of pain, and sometimes of sharp rise of temperature; it rarely troubles them more than a few days or a week, if they are kept quiet in bed with the leg rolled up in cotton-wool. It is good for the patient to remain on her back for the whole of the first fortnight, and until she gets on to the couch; but, if the back be tender, she may be allowed to lie over on the side, well supported with pillows, a little earlier. It is, of course, impossible to discuss at length the treatment of the complications which may arise. In aseptic cases they will be few, and opium and ice will be found all-powerful in subduing them.

In cases operated upon antiseptically, drainage will not be necessary in more than two per cent. When it is thought advisable to use it, Keith's modification of Koeberle's glass tube answers best. It should be long enough to reach to the bottom of the pelvis, and just protrude from the lower angle of the wound, with its mouth covered with a carbolised sponge; or it may be put through a hole in a small pure rubber sheet, the antiseptic dressing being applied closely round its mouth, and the sheet filled with carbolised sponges and fastened up. Whichever plan is adopted, it will be necessary to expose the mouth of the tube, under the spray, every six or eight hours at first, and then night and morning, and clear it with a glass syringe, to which a piece of red rubber tube is attached. When once introduced, it should be kept in till the serum from it is colourless and ceases to overflow into the sponge. It is a good plan to introduce a suture across the tube-opening at the time of operation, and leave it loose, to be tied up when the tube is withdrawn, otherwise the tube-opening causes a weak place in the cicatrix, which is liable to lead to ventral hernia.

In cases operated upon without antiseptics, the tube will be much more often required, probably in from ten to fifteen per cent. of any ordinary run of mixed cases (i.e. simple and difficult). It must not be forgotten, however, that the tube, though useful for the escape of material which may putrefy and cause trouble, is

also a distinct source of danger, especially in non-antiseptic hospital cases, for it forms an open channel through which infective particles may find their way into the deepest recesses of the peritoneum. There is another element of danger in its use, and that is the matting of intestines round it, leading to obstruction, either immediate or remote.

If there is reason to suppose that an accumulation of putrid serum has gathered in the peritoneum, in any case where the tube has not been used, it may be advisable to puncture the pouch of Douglas through the vagina, with a Cock's trocar, and leave the canula in, retained in place by a Wells' spring; or a suture may be taken out at the lower angle of the wound, and a grooved director pushed down into the pelvis, behind the uterus. These proceedings are, however, rarely successful, as the blood-poisoning has generally gone too far before the accumulation is suspected, or before the surgeon can make up his mind to interfere.

When a patient, after ovariectomy, leaves the surgeon's care, she should be cautioned to keep quiet during the first menstrual period, as hæmatocoele from the pedicle is occasionally met with. The mention of this recalls a subject which may be named here, though it would more properly have found a place in the preparation of the patient for operation. It has long been the fashion to advise that ovariectomy, and similar operations on the uterus and its appendages, should be performed shortly after the conclusion of a menstrual period. This is a mistake; the best time to operate is from a week to a few days before the period comes on. A little consideration will show that this is theoretically as well as practically advisable. A metrorrhaxis, or false period, frequently follows the operation within twenty-four or forty-eight hours, this being especially the case when both ovaries are removed, and when the ligatures are tied very close to the uterus (i.e. on a short pedicle). Just before this metrorrhaxis comes on, there is often pain, fever, and general upset; but as soon as the flow is established, a normal pulse and temperature are common. Theoretically, the nearer the proper time for menstruation, the more likely it will be to come on without disturbance, and this is found to be true in practice. Patients may even be operated upon during menstruation, without affecting the flow; but this is not advisable for many reasons. Young and middle-aged women, who have had both ovaries cleanly removed, rarely menstruate

again, but some have an occasional metrostaxis, which is preceded by a good deal of general constitutional disturbance. The majority of them also entirely lose sexual appetite; indeed, the exceptions are so rare that it may be presumed that, in these cases, a small portion of ovarian tissue has been left behind, or a third ovary has escaped notice. Patients who have had both Fallo-

pian tubes cleanly removed, and the ovaries left behind, continue to menstruate regularly. J. KNOWSLEY THORNTON.

OXALATE of LIME CALCULUS. See CALCULUS, Urinary.

OXALURIA. See URINE.

OZÆNA. See NOSE, Diseases of the.

P

PALATE, Diseases of the.—The palate, owing to its structural continuity with the alveoli and gums in front, and its connection posteriorly with the tongue and pharynx by means of the pillars of the fauces, is liable to implication by the extension of disease from these parts; whilst, on the other hand, morbid processes originating in the palate may spread to the neighbouring portions of the mouth, fauces, or pharynx.

It is necessary to recollect that the palate, with the posterior pillars of the fauces, constitutes a septum between the nasal and buccal passages, which by the contraction of the palato-pharyngei becomes complete during the act of deglutition, and then cuts off all communication between the two cavities; and that its structural and functional integrity is essential for perfect articulation, suction, and deglutition. Hence, the chief symptoms induced by lesions of the part are usually dependent upon impairment of these physiological acts.

The diseases of the palate are—(1) congenital malformations (see CLEFT PALATE), (2) inflammation, (3) ulcers, (4) necrosis, and (5) tumours.

1. **INFLAMMATION** may consist of a simple phlegmon of the soft parts; or, in the case of the hard palate, may involve the periosteum and bone.

(a) *Phlegmonous inflammation* is rare except as a result of extension from the tonsils and other adjacent parts. In the velum palati it is accompanied by considerable swelling; but this sign is absent in the hard palate, owing to the intimate adherence of the mucous membrane to the bone. It may terminate in abscess.

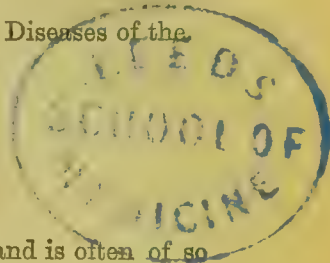
(β) *Syphilitic Angina*, which coincides in period with the early cutaneous manifestations, is usually most marked in the palate. It appears as a diffuse redness, with more or less swelling of the mucous

membrane of the fauces, and is often of so little intensity that it may be entirely unnoticed by the patient; but occasionally it assumes a parenchymatous form, and may lead to abscess-formation or even to sloughing of the soft parts. It may also become chronic, lasting two or three months.

(γ) *Osteo-periostitis* may arise from traumatic causes, extension of alveolar inflammation, or from syphilitic or tubercular cachexia. The disease is indicated by a local swelling, at first hard, then fluctuating; and there is more or less pain (slight in the syphilitic form) in mastication and deglutition. Should abscess supervene, the bone usually perishes, and its bared surface may be felt through the opening of discharge. The separation of the sequestrum may leave a temporary or permanent fistulous communication between the mouth and nose.

2. **ULCERS.**—The principal forms of ulceration of the palate are of syphilitic, tubercular, or epitheliomatous origin. Simple ulcers are rare except as a result of local injury, and present no special features of interest.

Syphilitic ulcers may be superficial or deep, as in the rest of the bucco-pharyngeal tract. See STOMATITIS. The former is common in the early secondary stages of the disease; the latter belongs to the tertiary period, and results from the breaking down of a gummatous infiltration. The deep ulcer appears late, from five to eight years after the primary lesion, and is generally single. If situated upon the hard palate it is nearly always central, and involves the bone; if the soft palate be the point of attack, great destruction and deformity may result, sometimes complicated with adhesions to the posterior wall of the pharynx. In rare instances the tertiary ulcer may spread to the base of the cranium. The sore has the usual characters.



Tubercular ulcers are most frequently developed in childhood. They usually reach the palate by extension from the posterior pillar of the fauces, and are associated with tubercular disease elsewhere. The lesion generally makes its first appearance in the form of small tubercles, which project slightly above the surface:—these break down into a number of erosions which soon fuse into an irregular ulcer of little depth characterised by festooned borders, and a yellowish base covered with pale granulations. The sore thus formed tends to travel slowly in a serpiginous course, but seldom leads to serious destruction.

Epitheliomatous ulcers are excessively rare as primary lesions of the palate, but may extend to the part from the gum or tonsil (q.v.).

3. TUMOURS.—In addition to inflammatory, tubercular, and gummatous swellings, the palate is subject to a considerable number of true tumour-growths, which may be briefly enumerated as follows:—

Cysts, mucous and dermoid; Fibroma; Enchondroma and Osteoma; Myxoma; Lipoma; and Adenoma.

The glandular tumour is by far the most common of the palatal neoplasms. It is often found upon the hard palate, generally implicating its lower wall on one or other side, and may reach the size of an egg or even attain larger dimensions. It is soft and elastic to the touch, painless and insensitive, and causes no symptoms beyond the inconvenience attached to its encroachment upon the buccal cavity. Structurally it follows the type of the salivary glands; it is invested by a capsule, and is united to surrounding parts by a somewhat loose connective tissue. The glandular elements of the soft palate may undergo hypertrophic changes, by which the thickness of the velum becomes greatly augmented, a condition which is probably analogous to the enlargement of the lip in strumous children.

Erectile tumours are almost confined to the hard palate, but the velum may be implicated by a nævus extending from the inner surface of the cheek. Papillomata, in the form of small, usually pedunculated growths, are not very infrequent, and are most commonly attached to the posterior border of the soft palate and to the uvula.

Sarcoma is rare. The tumour is usually of the round-celled variety, but in one instance was found to consist of fusiform and myeloid cells.

Epithelioma is rarely developed primarily in the palate, but may involve the

part in association with the tonsils and nasal fossæ, &c. The thyro-hyoid and carotid glands become affected at an early period of the disease.

Treatment.—The treatment of inflammatory and ulcerative affections of the palate should be conducted on the same principles as in other parts of the mouth. *See STOMATITIS.* Of the tumours, the cysts, fibromata, enchondromata, myxomata, and lipomata, all of which are rare, may ordinarily be removed with the knife. Adenomata are, as a rule, most easily enucleated with the finger-nail or curette. Erectile tumours are best attacked by means of coagulant injections or galvanopuncture. Papillomata may be cut off with the thermo-cautery scissors. Sarcomata, if not too extensive, may be excised. Epithelioma and carcinoma are seldom met with in a condition susceptible of any but alleviative treatment; but if small may be removed, or their destruction may be attempted by means of the galvanocautery.

The chief danger attached to the operative treatment of palatal tumours is the ingress of blood into the trachea, an accident especially liable to occur when the patient is under the influence of chloroform or ether. Fortunately, the surgeon is now provided with a local application which renders it possible to dispense with general anæsthetics in many cases. The use of a solution of cocaine painted upon the surface, or injected into the substance of the part to be subjected to operation, will commonly allow the painless removal of the growth while the patient retains consciousness and is able, in some degree, to guard the air-passages. Should it, however, be absolutely necessary to induce general anæsthesia, or should the danger of asphyxia threaten despite the absence of unconsciousness, the operation may either be performed while the head hangs down over the end of the operating table, so that the blood passes into the nares; or the back of the fauces may be plugged after a preliminary tracheotomy.

WILLIAM ANDERSON.

PALATE, CLEFT, The Mechanical and Surgical Treatment of. *See* CLEFT PALATE.

PALMAR ARCH, Wounds of the. Special interest attaches to wounds of the palm on account of the liability to injury of one or other of the palmar arches, the superficial being that most frequently

involved. When the wound is extensive, it may be possible to secure the divided ends of the vessel, but the most serious difficulty is met with in the cases of small punctured wounds dividing the artery, such as are caused by a penknife or piece of glass. If the puncture is found to run in a direction towards the artery, and if constant or recurrent hæmorrhage ensues, as the nature of the parts does not allow of the enlargement of the wound, other methods of stopping the hæmorrhage must be resorted to. Of these, pressure systematically applied will generally be attended with success. The wound having been cleansed, and all bleeding being temporarily arrested by compression of the brachial artery, the fingers should be separately bandaged, and a graduated compress carefully applied over the wound. The bandage securing this should be carried up the arm, and should also fix two oblong pads placed over the radial and ulnar arteries, so as to limit, but not entirely check, the amount of blood passing through them. A splint should then be applied to the forearm, and the fingers so bent over it as to relax the palmar fascia. The limb should be raised as high as possible. The patient lying in bed, this can be effected by pillows, or better, by a pulley and counterpoise. No hæmostatic solutions should be used, on account of the danger of sloughing of the tissues. If, after a fair trial, these measures do not succeed in restraining the bleeding, it will be necessary to ligature the brachial artery in the arm, or the radial and ulnar in the forearm. The choice of operation should be guided by carefully ascertaining whether digital compression of the two latter vessels entirely controls the hæmorrhage. If there be any doubt on this point, it is wiser to ligature the vessel in the arm, since the interosseous and median arteries may largely supplement the vessels of the forearm.

A *palmar aneurism* is formed when the vessel is divided or punctured, and remains open after the superficial wound has closed. The blood is poured out into a circumscribed cavity, which is limited by lymph effused from the surrounding tissues; and the tendency of the effusion is to spread either towards the ball of the thumb or towards the ulnar side of the palm. The symptoms are identical with those of traumatic aneurism in other parts, but the treatment here should not be to lay open the sac and ligature the divided ends of the vessel, but to apply pressure as above directed, and this measure will in most cases effect a permanent cure. Should it

fail, however, it will be best to apply the same rule as in the case of wound of the arch, to determine the selection of the artery to which a ligature should be applied.

JOHN H. MORGAN.

PALMAR FASCIA, Contraction of. See DUPUYTREN'S CONTRACTION.

PANNUS. See *Trachomatous Keratitis* under CORNEA, Inflammation of the.

PANOPHTHALMITIS. See EYE, General Examination of the.

PAPILLOMA.—Under the general designation of papilloma are comprised numerous conditions of the skin and mucous membranes, which, if of the skin, are usually of a dense, horny, non-sensitive character; or, if of the mucous membrane, are often highly vascular and sensitive. Among the affections comprised in these two groups are included corns, moles, common warts, condylomata, mucous tubercles, and verrucæ of the genital organs, which may be regarded as vegetations or excrescences arising, for the most part, from the stimulation of acrid discharges or other less pronounced forms of irritation. All are forms of hypertrophic papillary structure, which may subside on the cessation of the cause, or are readily curable.

It is a question whether the term 'papilloma' should be given to these, or should not rather be reserved for the comparatively rarer outgrowths which may be found on the skin and mucous membranes, such as the horny excrescences of the scalp, and the coarse, fringe-like vegetations seen in the axilla, flexures of the groins and scrotum, or around the anus; or for those similar growths on mucous surfaces which occur in the mouth and larynx, or as the so-called villous tumour of the bladder, and the highly vascular polypoid-looking growths which cover the rectum.

Cause.—Excepting, of course, congenital moles, papillomatous affections are all alike directly due to some form of irritation—usually some stimulating secretion—which may be of a specific nature—or they may be the result of pressure, as in corns, or of friction of neighbouring parts. In the majority of cases the source of irritation is at once apparent, but in others it is not clear, and one may find only some predisposing cause, such as residence in the tropics or an abnormally moist skin.

Pathology.—All papillomata are essentially hypertrophies, and, since a papilla has a definite structure, and is not merely

a tissue, such homogeneous texture as is seen in lipoma and fibroma cannot be expected in these affections; hence the hypertrophy may, as it does indeed, involve more markedly different strata of the papillary structure under differing conditions.

In construction the papillary type is nearly always readily recognisable, in spite of the excess of dense cuticle overlying the papillæ. The microscopic characters are also, as a rule, very distinctive and well-marked at the free surface; whilst at the base, in some of the larger chronic growths, an amount of connective tissue embracing closely packed cells generally exists.

Whilst quite benign as a general rule, it is well to remember that apparently simple warts, especially on the scrotum, face, and hands, may, as the result of long-continued irritation, become cancerous.

Symptoms and Diagnosis.—The warty character and raised surface distinguish papillomatous growths of the skin from any form of tumour or ulcer; and although on any mucous surface where they are found—rectum, bladder, or larynx—their external characters vary, yet the peculiar outstanding fringe-like surface exists in all. *See VILLOUS TUMOURS.*

Treatment.—Putting aside the conditions which have a venereal origin, to be treated as part of a general complaint, all plans for curing papillomatous affections should proceed, in the first place, on the principle of removing the cause when such exists. If the affection does not disappear upon the cessation of the cause, it must be dealt with radically, either by caustics, escharotics, or ligature, if small and localised; larger growths, and especially any whose bases are indurated, should be somewhat widely removed by the knife, scissors, or even *écraseur*. ALFRED WILLETT.

PAQUELIN'S CAUTERY. *See CAUTERY.*

PARACENTESIS. — Paracentesis means literally a pricking through, and the term is employed to signify the tapping of a cavity by means of a puncture, as opposed to the evacuation of its contents by means of an incision. It is generally confined to tapping the abdomen, the pleura, the pericardium, or the ventricles of the brain.

Paracentesis may be performed either with the aspirator or with a trocar and canula, the latter being often specially adapted for the cavity which it is required to puncture. The method of using the aspirator will be found under *ASPIRATION*; with regard to the use of the trocar, a

few general points may here be stated. First, it is sometimes thought advisable to make a minute preliminary puncture through the skin with a scalpel, in order to facilitate the introduction of the trocar; but, if the instrument be sharp, and if the canula do not project beyond the neck of the trocar, this precaution, which involves increased pain to the patient, is, in most cases, wholly unnecessary. Secondly, it is of importance, during the process of tapping, to guard against the entrance of air, which, in the case of any of the cavities under consideration, may happen from powerful respiratory movements on the part of the patient. This accident may be guarded against, in some cases, by keeping up firm pressure upon the surface of the part which is to be emptied; but it may be more securely attained, in the case of the chest or abdomen, by employing a canula to which an india-rubber tube is attached, the other end passing beneath the surface of some antiseptic fluid, contained in a vessel placed below the level of the patient's body.

A convenient arrangement is that in which the trocar forms the end of a piston hermetically fitting into the canula, which is prevented by a stop at the outer end of the latter from being completely withdrawn; the part to which the caoutchouc tube is fixed leaving the canula at some point in its side. The trocar, on being withdrawn to the utmost possible extent, does not allow the entrance of air into the canula, and the fluid flows out through the lateral opening. This instrument presents the disadvantage of being rather difficult to clean, which leads to the observation that it is a matter of the greatest importance that, whatever instrument be used, every part of it should have previously been thoroughly washed with a strong antiseptic material (carbolic acid lotion, 1 to 20, is the best). For it may easily happen that an instrument, which in the ordinary acceptation of the term is clean, may introduce the causes of putrefaction into the cavity operated upon, and may change a simple and aseptic serous effusion into a collection of stinking pus, thus endangering the health, or even the life, of the patient. Thirdly, it is well to draw the skin slightly to one side before making the puncture, so that the track made by the instrument may ultimately be valvular, and the leakage of fluid after its withdrawal may thus be prevented. Fourthly, the slight pain of the puncture may, if it is thought advisable, be prevented by freezing the skin of the part either by the application of ice and salt, or with the ether spray.

PARACENTESIS THORACIS.—The description of paracentesis thoracis will be found in great measure in the article EMPYEMA. Paracentesis, as opposed to free incision, is, however, seldom to be recommended for the evacuation of pus from the thoracic cavity, and in its application is chiefly confined to cases of serous effusion. If the aspirator be employed, it is well to use one in which a gradual exhaustion can be practised (the bottle aspirator), as opposed to the original instrument of Dieulafoy; it being unadvisable to run the risk of producing, by sudden exhaustion, the rupture of some small vessel in the lung, and so giving rise to a hæmothorax. For the same reason, it is best to employ a canula and trocar and not a perforated needle, so that, on withdrawing the trocar, the lung is free from the risk of being wounded. By a suitable arrangement of stopcocks (namely, by interposing a three-way tube into that leading from the canula to the bottle), it is easy to convert the aspirator into a syphon, and so empty the chest without risk of producing undue negative pressure. It should be remembered that, in performing paracentesis thoracis, it is not intended to empty the chest. In the first place, it is generally impossible to do so; in the second, it is not necessary, because the removal of part, sometimes even of a comparatively small quantity of a serous effusion, is usually followed by the complete absorption of the rest; and thirdly, the removal of a very large quantity may occasionally lead to dangerous collapse.

The rule is to continue the evacuation, if the patient's pulse and general condition remain good, so long as it takes place readily, producing no cough; but to stop at once if there be any cough or the slightest appearance of blood in the fluid drawn off. The aspirator in most cases answers the purpose extremely well; but if it be decided to employ a trocar and canula, either because the fluid contains flakes of lymph which do not readily flow through a fine tube, or for any other reason, such an instrument as that mentioned above may be used; or one which is flattened may be found more convenient, if the ribs be naturally close together, or if they have been approximated by contraction of the chest. It is not only important to see that the canula fits close round the neck of the trocar, but also to take the precaution of plunging it with one thrust through the thoracic parietes, regulating the distance to which it is made to enter the chest by placing the index finger at a suitable spot on the side of the canula.

In this way, the accident of separating the pleura from the ribs and pushing it before the trocar—a not uncommon one—is effectually avoided. If neither of the instruments described be at hand, an efficient arrangement for preventing the entrance of air into the chest may be made by attaching a piece of muslin, folded as when used for a petticoat-tube, to the end of the canula. During the puncture it is held round the trocar, and afterwards, whilst fluid escapes readily from it, it is impossible for air to find its way back through it.

It may be mentioned here that Mr. R. W. Parker, with a view of more completely removing the fluid than is otherwise possible, has suggested and put in practice the plan of puncturing the chest at another point with a fine needle, which communicates, by means of an india-rubber tube, with a bottle containing cotton-wool or some other means of purifying the air that passes through it. In this way purified air enters the chest as the fluid escapes, and the hydrothorax is converted into a pneumothorax, the air being, as was hoped, subsequently absorbed. Sufficient experience has not yet been obtained to warrant the recommendation of this procedure.

The spot to select for puncturing the chest is a matter of small consequence, only it is advisable not to go too low, for fear of injuring the diaphragm. About the sixth or seventh space, just in front of the posterior fold of the axilla, is usually found the most suitable position.

PARACENTESIS ABDOMINIS may be performed with the aspirator or the trocar; or another method may be employed, which was suggested by Dr. Reginald Southey—viz. the introduction of several minute perforated needles, through which the fluid escapes *guttatim*. These are left *in situ* for a considerable time, and it is maintained that the effusion can, by this plan, be removed with less chance of collapse than is involved in the more rapid processes, and without entailing any risk of consequent peritonitis.

If either of the other plans be adopted, a few precautions are necessary. First, it should be ascertained that the bladder is empty, so that the instrument may not pass into this viscus instead of into the peritoneal cavity; secondly, it must be demonstrated that there is dulness at the point selected, so that it may be certain that no coil of intestine is punctured, as may happen, even though the peritoneal cavity be full of fluid, if the bowel be bound to the abdominal wall by adhesions; thirdly, a wide, many-tailed

bandage should be made to encircle the abdomen, the ends of which should be firmly tightened by assistants standing upon each side of the patient, a hole having been previously cut in it opposite the point to be punctured. In this way the flow of the fluid is encouraged if the simple trocar be used, and the tendency to collapse of the patient, from the sudden diminution of pressure, is prevented. After the completion of the operation the bandage is not removed, but its ends are firmly secured on the front of the abdomen, after previously carefully sealing the puncture with collodion to prevent the possibility of leakage, such leakage being not unlikely to lead to peritonitis.

The spot usually chosen for puncture is in the middle line, midway between the umbilicus and the pubes, though circumstances may arise in which other situations are more advisable.

PARACENTESIS CAPITIS is performed for chronic hydrocephalus; it is not an operation from which, to judge by experience, much, if any, advantage is to be gained, the fluid almost always, if not invariably, collecting again with more or less rapidity. It is, however, a proceeding which, if carefully performed, appears to involve little or no risk to the patient. The fluid is usually in the distended cerebral ventricles; but the distension is so great that the brain substance covering it is much thinned, and it is therefore found at a very short distance from the surface. A fine exploring trocar is the right instrument to employ, and an ounce or two of fluid should, as a rule, be the limit of the amount withdrawn. The writer has, however, in one case adopted the plan of purposely leaving the puncture unsealed, so that the fluid might drain away after the manner of paracentesis abdominis by Southey's tubes; but, although no mischief in this case resulted, he is not disposed to recommend the plan to others, for on carrying out the principle a step further, and introducing a single horsehair into the puncture, a sharp attack of meningitis was the result. It would obviously be unwise, in dealing with such a delicate organ as the brain, to withdraw a large amount of fluid suddenly, and, *a fortiori*, to employ the aspirator for the purpose. The surgeon may select any point, away from the position of one of the sinuses, where the bony part of the skull is absent. Such spots are usually plentiful in cases of chronic hydrocephalus in young children, and a convenient place will be found, at a short distance from the middle line, in one of the usually widely gaping

limbs of the coronal suture. It is needless to say that in older children, where the skull is completely ossified, the operation is neither called for nor admissible.

PARACENTESIS PERICARDII is an operation which has suggested itself to many surgeons and physicians, but has not till comparatively recently been much used. Trousseau was in favour of employing the bistoury for the operation, but it can hardly be doubted that it is more safely performed with a fine exploring trocar or the aspirator; for it must be remembered that, although the pericardium is for a considerable extent uncovered by lung, the pleura on the left side reaches almost, if not quite, as near to the middle line as on the right side. Thus, unless the instrument is passed quite close to the sternum in the fourth or fifth interspaces, it must almost necessarily pass through the pleura, if this be not already obliterated by adhesions; and, although the passage of the aspirator needle will be probably productive of no evil consequences, the admission of air into the pleura, which will almost necessarily follow the use of the bistoury, would be an unfortunate and serious complication. The instrument is to be passed then close to the sternum in one of these spaces, or at such a distance from it as to avoid the internal mammary artery, which is coursing downwards behind the costal cartilages, and it should be directed obliquely upwards and outwards so as to avoid puncturing the heart. Dr. S. West strongly recommends the fourth interspace, at one inch from the end of the sternum, but the third, the sixth, the seventh, and the eighth have been selected, and in three cases at least the pericardium has been reached on the right of the sternum. It may be mentioned that simple puncture of the heart with a needle is not likely to be followed by any serious consequences, as is shown by the fact that it has been occasionally done accidentally, and sometimes purposely, for the sake of producing contraction of the ventricle in apparent death from chloroform. In Dr. Samuel West's case, and in some others, a drainage-tube was inserted into the pericardium, and the patients recovered; in one case the opening was made through the pleura, which had previously been incised for the evacuation of an empyema. RICKMAN J. GODLEE.

PARAMETRITIS. See PELVIC CELLULITIS.

PARAPHIMOSIS is the retraction of the prepuce behind the glans penis, where it becomes fixed owing to the constriction

of the preputial orifice. In childhood, the deformity is caused by the retraction of a long foreskin with a contracted orifice. In adults, this may also be the cause, and paraphimosis is not infrequently brought about during coitus. It may also arise as the result of venereal infection. The extension of a balanitis to the preputial mucous membrane having inflamed and thickened the prepuce, a successful attempt is made to retract it behind the glans, when it is found impossible at the moment to replace it. It is obvious that the tight, constricting band of the preputial orifice behind the glans, is the immediate cause of the return of blood from the part being prevented. Oedematous swelling soon comes on, and in cases where relief has not been soon afforded, ulceration or even sloughing of the glans has been known to take place. It is of importance to recognise the exact spot at which the constriction is situated. Immediately behind the glans is a furrow, deeper on the dorsal aspect. In paraphimosis there will be noticed behind this furrow a fold of swollen mucous membrane, and then another and deeper sulcus. This second sulcus represents the mucous membrane of the preputial orifice, and is the site of the constriction.

The *treatment* should be directed to secure immediate reduction. In ordinary cases this may be effected as follows: oil the glans penis well, then lock the fore-fingers of both hands above and behind the glans, and the middle fingers below. With both thumbs make steady pressure on the glans, at the same time endeavouring to slip the prepuce forward by traction with the fingers. The operation is a painful one, and in children it may be needful to administer an anæsthetic. Should this manipulation fail, an attempt should be made to reduce the swelling by the application of an elastic band wound firmly round the glans. On this being rapidly unwound, it may be possible to slip the prepuce over the diminished glans.

When, however, it is found impossible by these means to reduce a paraphimosis, recourse must be had to incision. Remembering the description given above as to the point of constriction, a vertical incision half an inch long should be made at that spot with a curved, sharp-pointed bistoury. The constriction immediately yields, sometimes with a snap, and reduction is effected with ease. The after-treatment consists of injections of carbolic or boracic acid lotions, and warm fomentations if pain and swelling should continue.

PAUL SWAIN.

PARONYCHIA. *See* WHITLOW.

PAROTID TUMOUR.—The tumours growing in the substance, or upon the surface, of the parotid gland, most commonly met with, and to which the name of 'parotid tumour' is usually applied, are of a cartilaginous nature. But, mixed with the cartilage is usually a variable amount of soft embryonic connective tissue (myxoma), together with fibres enclosing spaces wherein are contained cells resembling those proper to a lymphatic gland.

These tumours are irregularly lobulated in shape and of firm consistence, giving a sense of elasticity to the touch, with here and there softer portions. They are enveloped in a dense capsule, and usually embedded in, and closely adherent to, the substance of the parotid gland. Sometimes they are freely movable upon the parts beneath, but more often they are covered by the fascia of the parotid, and have made their way between the lobes of the gland, which may be partially absorbed by their pressure. Thus, while the greater part of the tumour may project beneath the skin, in front of or behind the lobe of the ear, there may also be processes extending deeply behind the ramus of the jaw, even down to the styloid process and carotid sheath; and the facial nerve or some of its branches, and the external carotid artery and jugular vein are often adherent to or surrounded by some part of the growth.

These tumours increase slowly, and do not often attain a very large size; they are non-malignant, and are troublesome chiefly because of the deformity they produce, and the pressure upon and displacement of adjacent structures.

Occasionally, however, parotid tumours are met with which recur after removal, or even exhibit malignant characters; these are usually softer, of more rapid growth, and with a tendency to early adhesion to the skin.

The only *treatment* applicable to a parotid tumour is removal; and this should be done early, so as to avoid, as far as possible, the dangers incident to its extension among the deeper tissues of the part. A free incision should be made over the posterior border of the tumour, and this may be joined, if needful, by another passing forwards at a right angle to the first. The capsule of the tumour should be opened to a corresponding extent, and the dissection kept as much as possible within it, for the capsule generally separates the tumour from the important adjacent struc-

tures. When, however, the tumour extends deeply, the dissection will always be difficult and require much caution, especially in following the processes of the growth which extend behind the jaw and in the direction of the styloid process.

The facial nerve or its branches may, however, be so intimately connected with the tumour that it will be impossible to avoid its division. But the resulting facial paralysis is not necessarily permanent. If the ends of the nerve can be found, they should be brought together by a fine catgut suture, and the function of the nerve may be re-established. If, however, any considerable portion of the nerve is removed, or if there be much suppuration in the wound, the paralysis will persist. Every care should, therefore, be taken to secure immediate union of the wound, the edges of which should be carefully adjusted with fine sutures, for the vascularity of the tissues of the face and neck favours the rapid healing of even extensive wounds.

J. WARRINGTON HAWARD.

PATELLA, Dislocations of the. There are five dislocations of this bone: viz. *outwards, inwards, upwards, by semi-rotation* (edgeways), and *by complete version*.

DISLOCATION OUTWARDS is the most common, and it may be *incomplete* or *complete*. When incomplete, the inner articular facet rests upon the cartilage of the external condyle, and the outer edge projects. When complete, the bone lies to the outer side of the anterior prominence of the external condyle. It is especially frequent in knock-kneed persons, which is to be explained as follows: Owing to the oblique direction of the rectus muscle from origin to insertion, during contraction it tends to displace the patella outwards, a tendency which, under normal conditions, is counteracted by the anterior prominence of the external condyle. With genu valgum the obliquity of the muscle is increased, and the prominence of the condyle no longer suffices, under these conditions, to prevent the patella from being displaced outwards. Occasionally it is produced by violence, or it may be *congenital*, and then is often associated with talipes or other deformity. A slight twist inwards whilst dancing, in a person of lax fibre with knock-knee, is often sufficient to cause this dislocation. It is, usually, easily reduced by pressure when the limb is raised. In cases of difficulty, violent flexion has sometimes been found to succeed after other means

have failed. The joint should afterwards be kept at rest till the synovitis has subsided, and a knee-cap, with a spring to support the patella in position, should be worn when the patient commences to walk.

DISLOCATION INWARDS is much less frequent than dislocation outwards, and is more often due to direct injury. It may, however, be caused by muscular action, especially where there is a tendency to genu varum. It may be *complete* or *incomplete*. In the latter case the inner edge projects, and the outer articular facet is applied to the inner condyle. Reduction is, usually, easily effected in a manner similar to that recommended for dislocation outwards, and as a rule little ill-result follows; but in one case, recorded by Key, suppuration and death resulted, though there was no external wound.

DISLOCATION UPWARDS occasionally occurs as the result of a sudden powerful contraction of the quadriceps extensor muscle, whereby the ligamentum patellæ becomes ruptured. In more than one case to which the writer has been called, under the belief that this accident had occurred, he was able to distinguish the extreme tip of the patella attached to the upper end of the ligament, and the case was, therefore, really a fracture. The treatment should be precisely the same as for fracture of the patella, that bone being held down by some mechanical contrivance until firm union of the ligament has taken place.

DISLOCATION BY SEMI-ROTATION.—In this very rare but interesting dislocation, the patella becomes rotated on its vertical axis, and so fixed between the condyles that its surfaces are directed laterally and its edges antero-posteriorly. It would appear to be brought about by a stage in rotation beyond that which prevails in the case of incomplete lateral dislocations; and either edge may be directed backwards and fixed between the condyles. The inner edge is more frequently posterior, and this is what one would anticipate from the greater frequency of the dislocation outwards. It has occurred in children of thirteen and fifteen, as the result of muscular action, but more often results from direct injury, and this has happened on several occasions during horse exercise. The leg is usually extended or slightly flexed, and the edge of the patella makes an unmistakable prominence in front of the joint. Reduction has, sometimes, been effected without difficulty by pressure and extension; in other cases, this method has completely failed, and the bone has been replaced by forcible

flexion. The extreme difficulty occasionally experienced, even after division of the extensor tendon and ligamentum patellæ, points to some other cause than muscular action as producing the fixation; but these cases appear to have been before the days of chloroform. Should all other means fail when the patient is under an anæsthetic, the writer would not hesitate, under proper antiseptic precautions, to make a small incision into the joint on the side of the patella, and there introduce a metal lever to raise the bone into position. His experience of antiseptic incision of the knee-joint, for the removal of loose cartilages and for knock-knee, quite justifies him in recommending this method under the restrictions stated; but without such care it would be hazardous, in illustration of which Wolff's case may be mentioned. This surgeon made a long open wound in front of the joint, in order to divide the extensor tendon and the ligamentum patellæ. He failed to replace the bone, and the patient died from suppurative of the joint.

DISLOCATION BY COMPLETE VERSION.—As dislocation by semi-rotation is one stage further than incomplete lateral dislocation, so complete version is a further twist on the vertical axis beyond semi-rotation. The articular facets of the patella are directed forwards, and its anterior surface faces the condyles of the femur, whilst the tendon above and the ligament below are twisted, and stand out as cords beneath the skin. Castara has related a case which occurred in a girl of seventeen, the patella being twisted from within outwards; and Sue has mentioned a case in which the rotation was from without inwards. Castara readily reduced his case by simply twisting it round with his finger and thumb. In cases of difficulty, the methods already described for dislocation by semi-rotation may be tried.

R. CLEMENT LUCAS.

PATELLA, Fracture of the.—This bone is most commonly fractured in males between the ages of twenty and fifty, though cases are occasionally met with in the young, and in persons advanced in life. It is much more common in men than in women.

Causes.—Though sometimes the result of direct violence, as of a fall on the knee, a kick, or a blow, it is most frequently produced by muscular action. When the knee is flexed to an angle of about 110° , the patella is mounted on the most prominent part of the condyles of the femur, in a position which, while it greatly increases the leverage of the quadriceps,

leads to so severe a strain when this powerful group of muscles suddenly contracts, that the bone frequently snaps across, a little below the middle. The fall which many believe has caused the fracture is, in fact, merely its result. Observant persons, indeed, have often reported that during a violent muscular effort they both heard and felt the bone snap, and that then, losing all power in the limb, they fell to the ground. Transverse fracture may occur at any level, sometimes so near the ligamentum patellæ that the lower fragment is so small that it can scarcely be felt; sometimes near the upper limit of the bone. Occasionally, the quadriceps extensor not only produces a transverse fracture, but those of its fibres which are attached to the sides of the bone lead to vertical fracture and wide lateral separation of the fragments. When the result of direct violence, the fracture may be vertical, oblique, or comminuted and stellate. Morris mentions a case of incomplete fracture involving only the articular aspect of the bone. Compound fracture is rare, and is probably always due to direct violence.

In the great majority of cases, fracture of the patella extends into the joint, though, when it is seated at the lower non-articular portion of the bone, the soft parts may shut it off from the synovial cavity. The amount of separation of the fragments depends on the degree to which the aponeurotic structures at the sides of the patella are torn. When these escape injury separation is slight, but when, as is often the case, they are extensively lacerated, and when effusion occurs into the joint, the gap between the fragments becomes proportionately great. Immediately after the injury the knee-joint frequently becomes distended with serum and blood, and considerable extravasation may occur into the soft parts about the front and sides of the knee. Synovitis following the accident may add to the swelling of the joint. Suppuration very rarely takes place. Necrosis following fracture of the patella is a very rare event, though a few examples of it have been recorded.

Symptoms.—In the majority of cases the local symptoms are plainly marked, but occasionally they are so obscure that the injury may be easily overlooked. In transverse fracture, the fragments are generally separated by a distinct interval, which is increased on slight flexion of the limb, a movement, however, which should be used only in doubtful cases, and then with the greatest gentleness. When pressed from side to side in opposite directions, the frag-

ments can be felt to move on each other, or when one is tilted by pressure on its lateral border, the other is found to remain at rest. In transverse fracture with little separation, or in vertical or stellate fracture, the fragments may be moved on each other and crepitus be sometimes obtained. On tracing its borders, irregularity in the outline of the bone may be detected. Though the patient usually loses all power in the limb at the moment of the accident, and finds that any attempt at movement causes severe pain, it must not be forgotten that many cases are on record in which persons, with recent fracture of the patella, have been able not only to extend the leg but to walk for some distance, and even to walk upstairs upon the limb. Care must be taken not to mistake for the evidences of fracture either (a) the ridges and irregularities that are sometimes to be felt in a thickened bursa patellæ resulting from repeated attacks of inflammation; or (b) the hard edges of an effusion of blood following a blow and soon becoming firmly coagulated in the meshes of the periosteum; or (c) the sensation of crepitation which may be produced by the presence of recent blood-clot in the bursa; or (d) the altered shape of the bone resulting from osteo-arthritis. In some instances, fracture of the patella has been mistaken for mere traumatic synovitis, and has been detected only when effusion into the joint has been absorbed.

Transverse fracture of the patella is rarely united by bone. The possibility of this form of repair, however, is proved by many museum specimens in which a section across the line of fracture has been made. Generally, when separation is only moderate, the fragments are connected by a thick and broad ligament which occupies the interval between them. When the ends are wide apart, a band may extend between them consisting either of newly organised material more or less substantial, or of part of the thickened capsule, blended perhaps with the walls of the bursa patellæ. In many instances the fracture remains ununited, and the joint is closed in front only by the integuments. Although, when the patient leaves the surgeon's hands, the fragments are close together or are separated only by a slight interval, the uniting band may, with subsequent use of the limb, gradually stretch, so that a gap of from an inch to four or even six inches is formed.

A patient, who has once sustained fracture of the patella, is very liable to a repetition of the accident in the same or the opposite limb. In re-fracture, the bone

generally gives way above or below the uniting ligament, but in some cases the ligament itself is torn. Instances are on record, in which the same patella has been broken at as many as four different levels. Occasionally, both patellæ are broken at the same time. In some cases repair leaves the knee-joint stiff, and the patella fixed by fibrous adhesions to the condyles; no attempt, however, involving any force, should be made to restore movement by flexion, lest in doing so the union of the patella should be weakened.

Treatment.—The objects to be aimed at are the approximation and retention of the fragments in position, and a quiescent condition of the extensor muscles. When the joint is distended with effused blood and serum, or when acute synovitis has come on, no retentive apparatus can at first be used. The knee should be fully extended, and the limb raised to an angle of about 140° with the trunk. The joint should be covered with an ice-bag, or with evaporating lotion. In order to reduce swelling, some advise that the joint should be aspirated. This, however, although it has often been safely done, and although its effect is to allow the fragments to fall towards each other, is a proceeding which certainly is not essential, for the generality of cases do well without it; nor can it be regarded as free from the chance of an occasional serious mishap. It should, therefore, at least be reserved for cases in which the separation of the fragments is very considerable.

As soon as the joint will safely bear it, means should be taken to bring the fragments together. Owing to the prolongation of some of the fibres of the quadriceps tendon downwards over the superficial aspect of the patella, the upper fragment is prone to be tilted so that its broken surface, instead of presenting directly towards the lower fragment, looks upwards and forwards, and so that the interval between the ends is V-shaped, with its base outwards. Hence, although the fragments may be in firm contact on their deep aspect, they still show a gap in front, which it is often difficult or impossible entirely to remove. But this is not very material, for experience abundantly shows that, while bony union is very rare even when the fragments seem closely in contact, in the great majority of instances in which the ends are separated only by a moderate interval (less than three-quarters of an inch—and the space can usually be reduced to these limits), such firm ligamentous union will occur that the patient re-

tains almost perfect use of the limb. This ligament, indeed, is so strong that, in any subsequent injury, not it but the bone itself at some other level usually gives way.

In Steavenson's method, which is often successful, the limb is placed in a back splint, and the fragments are drawn together by two elastic bands, one of which passes from a hook at the inner side of the back splint below the knee, upwards over the superior fragment, and then returns to a hook on the outer side of the splint below the knee, while the other band passes in an opposite direction, is similarly fixed, and acts on the lower fragment. Another plan is the following:—A broad piece of stout moleskin strapping is cut, at one border, into the shape of a horse-shoe, with the ends prolonged. This is applied to the thigh so that its concavity surrounds the upper fragment, and is fixed by a bandage. The limb is now placed on a well-padded McIntyre or wooden back-splint, with a footpiece. The lower fragment is next fixed by a pad of lint, and with strapping passed around the limb and splint together. A bandage is then carried upwards over the limb and splint from the foot to the level of the lower fragment, and another is applied in a similar way to the thigh. To the two ends of the moleskin pieces of webbing are now sewn, and these are connected with india-rubber accumulators, which in their turn are fastened to a loop of webbing passed round the footpiece of the splint. By tightening this loop the upper fragment can be drawn down. It is best to introduce a pad beneath the concave edge of the moleskin, so as to avoid ulceration of the skin.

Malgaigne's hooks enable us to act directly upon the fragments, drawing them more closely together than any other method, and some surgeons still employ them. Their use, however, has been followed by diffuse inflammation round the patella and even by suppuration of the knee-joint, ending in some cases fatally, in others in ankylosis. Nor do they by any means ensure bony union. Hence, they have never come into general favour, and cannot be here recommended. In a serviceable modification of Malgaigne's plan two thick pieces of moleskin plaster cut out at their margins to fit the patella are applied, the one above and the other below the fragments, and the hooks are fastened into and made to draw upon these instead of being fixed into the patella itself.

The operation of opening and wiring the fragments together, first practised up-

wards of five-and-twenty years ago, has lately been advocated and practised by Sir J. Lister and others. In speaking of this proceeding, a line must be drawn between recent and old cases. (a) In recent cases the fragments are no doubt generally brought easily together, and, as a rule, the operation is attended with no serious complication; while in many instances, so far as examination shows, bony union is obtained. It may also be allowed that in a successful case much time is saved. The objections, however, to the operation are: (1) that a very satisfactory result is generally to be obtained without it, so good indeed that the patient is conscious of no impairment of the limb; (2) that bony union after it can by no means be guaranteed; (3) that it entails, as some cases have already only too plainly demonstrated, the risk of suppuration of the joint and other very serious complications. These objections are, in the eyes of the great majority of surgeons, fatal to the adoption of this method. (b) In cases of old fracture, with retraction of the fragments, it has been found difficult or impossible to bring them into contact, in consequence of the shortened condition of the quadriceps extensor. In some instances, even though the extensor has been completely divided, the fragments could not be brought together; in other cases, though adjustment was accomplished, no bony union occurred. In short, the prevailing opinion in regard to this operation is that in cases of recent fracture it is uncalled for; while in many cases of old fracture it is often impossible to carry it out in a satisfactory manner.

Refracture must be treated in the same manner as the primary injury. Unfavourable as the prognosis appears at first sight, the result is often very satisfactory, and it is surprising to see how fully the power of the limb is retained, even when the patella has become by repeated fractures divided into three or four fragments, united by intervening ligamentous bands. A source of weakness, after fracture of the patella, lies in the great atrophy which occurs in the quadriceps muscle. Something may be done to reduce the amount of wasting by hot douching and shampooing, and the use every morning and evening of a mild continuous electric current (six or eight cells).

Much difference of opinion exists as to the time during which, after fracture of the patella, some apparatus should be worn to prevent flexion of the joint. This period, however, must doubtless vary with the case.

When not only the patella has been broken, but the fibrous structures at its sides have been widely torn across, so that considerable separation has occurred and the uniting ligament is weak and apt to stretch, the knee ought to be kept in a straight position for six months; while in instances in which separation has been slight, and a strong and short ligamentous band has formed between the fragments, some flexion of the limb may be allowed after three months. Each case, however, must be watched to see whether the band is yielding and the gap between the fragments increasing, it being remembered that, in many instances in which union was close when the patient was dismissed, a gap of from four to six inches has gradually formed. Much, too, will depend on the patient's calling. If this involves the carrying of heavy loads, or is otherwise physically laborious, the extended position must be maintained much longer than would otherwise be necessary. A convenient apparatus for maintaining extension consists of a pair of antero-posterior leather splints, accurately moulded to the lower half of the thigh and upper half of the leg, and strengthened by light steel supports. The splints may be prevented from slipping by two narrow steel prolongations, fitting into tubular sockets in the sides of the heel of the boot. An excellent appliance, long used at the Middlesex Hospital, consists of a strong-laced leather knee-cap made in two pieces, one extending eight inches or more up the thigh, the other six inches or more down the leg, and connected with each other by steel rods on the outer and inner sides. These rods are jointed opposite the knee, the joint being so constructed that the amount of flexion which it allows, and which is at first very limited, can be gradually increased.

In cases of vertical or oblique fracture of the patella, the limb must be raised in the extended position, and the fragments readjusted and maintained in place by pads and circular turns of a bandage. In many cases, however, of these fractures, separation is so slight that all that is necessary is to keep the limb at rest in the position just mentioned, and supported on a back-splint for four or five weeks, when the patient may be allowed to resume exercise gradually, the knee being at first guarded by a light back-splint, to prevent flexion.

HOWARD MARSH.

PEDICULI.—The presence of pediculi, or lice, upon different parts of the body, gives rise to a disease called phthiriasis,

which differs somewhat according to the locality. It is in reality a form of eczema dependent on the local irritation of the pediculi, and it differs according to the habits and situation of the pediculi which give rise to it. There are three kinds of lice which generally attack the body: *pediculi capitis*, *corporis*, *pubis*. The symptoms, which vary in the case of each of them, together with the diagnosis and treatment, which depend on a knowledge of their habits, must be considered separately.

PEDICULI CAPITIS.—*Symptoms.*—As a rule, the patient complains of soreness and great irritability of the head; or the glands in the occipital region especially, and also those in front of the ear and at the side of the neck are swollen and even suppurate, giving rise, at first sight, to the notion that the patient is strumous. But the hair is matted together, especially at the roots, with thick crusts and scabs, and a very slight examination will reveal the presence of eczematous patches and small erosions on the scalp. Sometimes, especially in women with long hair, the erosions are deep and inflamed, and the skin is pigmented under the long hair in the neck. If this be lifted up, the pediculi will soon proclaim their presence by their active movements.

Diagnosis.—An examination of the individual hairs will complete the diagnosis, if anything further be required. Fastened to them, usually close to their roots, will be found the nits or eggs (small grey masses about the size of a small pin's head). One only, as a rule, is found on each hair; if more than one is present, those nearest the root are the newest, and if the nits are situated more than an inch from the head, it is quite certain that the disease has existed for some time, as the hairs have had time to grow considerably since the nits were deposited upon them. It is important to observe the exact way in which the nits are attached to the hairs, for without such knowledge they cannot be thoroughly removed. Around the hair will be found an elongated ring, which is cemented to the hair, and to the outside of which the nit is attached. For this examination a small magnifying glass should be employed. The pediculi themselves are small grey insects, having their habitat near the hair-roots, where they are warmest and safest. They are about $\frac{1}{10}$ of an inch in length, and capable of very active movements. They escape from the nits about nine days after these have been deposited. Nine days later they are full-grown, and in about nine more are capable of reproduction.

Treatment.—From the above description it is obvious that the treatment must be directed, not only towards killing the lice, but likewise to the destruction of the nits. The simplest plan, by far, of effecting this object is to shave the head, which plan leaves nothing but the eczema to treat. This is readily cured by any simple emollient, such as vaseline, zinc ointment, or one part of liq. plumbi subacet. and two parts of olive oil. If, for any reason, it is desirable to retain the hair, one of the following methods will be found to succeed admirably: a linseed-meal poultice mixed with carbolic acid (1 in 40 parts of water) readily kills the lice, without running the risk of letting any of them escape. The same end can be effected by washing the hair with plenty of soap and carbolic acid (1 in 40), or by applying equal parts of petroleum and olive oil, with enough Peruvian balsam to mask the smell. To get rid of the nits which still remain behind, daily washing is necessary, together with the use of a fine-toothed comb after the roots of the hair have been moistened with a little vinegar. The effect of this application is to loosen the little rings before described, by which the nits are attached to the hairs, and they can then be gradually drawn off the hairs by the aid of a fine comb, just as a ring is withdrawn from one's finger. This process should be carried on for at least a fortnight after the last louse has disappeared, after which time there is no fear of any more eggs being hatched.

PEDICULI CORPORIS.—*Symptoms.*—The chief symptom of this disease, as of the first, is, essentially, intense itching, but it is limited to the body, as these lice do not invade the head. The skin is marked by long scratches, caused by the nails of the patient, by wheals, papules, and even sores. In the worst cases the whole skin is dark and pigmented, from the extravasated blood which has become altered in the subcutaneous tissue, and the course of the lymphatics is marked out by lymphangitis. It is scarcely possible, with care, to mistake the disease for anything else; it has been, however, confounded from its colour with Addison's disease; from its wheals, with urticaria; and, from its scratches and ulcers, with impetiginous eczema.

Diagnosis.—To come to an absolutely certain conclusion, the clothes must be searched, as in them it is that the louse resides; the body is only his happy hunting-ground. Wherever there are folds in the clothes, e.g. just below the armpits, round the waist or the neck, the greatest traces

of his ravages will be seen, whilst in the axillæ and on the contiguous surfaces of the buttocks where the clothes never touch, no traces of the scratching are to be seen. It is essential that every article of clothing should be carefully examined, as, sometimes, an old flannel belt or truss may be the lurking place in the cleanest of individuals. The pediculus corporis or *P. vestimenti*, as it should be more properly called, differs from *P. capitis* in being larger and more active; the head is elongated and more oval, the antennæ larger, and the colour dirty white with blackish margins.

Treatment must be directed rather to the clothes than to the skin. If the clothes are boiled or baked, all the symptoms will speedily disappear. If these precautions be taken, it is not necessary to destroy the clothes. The treatment of the skin, if any be required beyond a warm bath, is the same as that prescribed in the case of *P. capitis*.

PEDICULI PUBIS.—*Symptoms.*—Itching, as in the preceding cases, is the most prominent symptom. It is more constant though not so violent as in *P. corporis*; and the scratches are more like those on a person affected with scabies.

The *diagnosis* is readily effected by searching for the louse, which is shorter and broader than *P. capitis*, has a fiddle-shaped head, and resembles a miniature tortoise. The two front pairs of legs are used for walking, whilst with the claspers on the hinder he sticks tight to the hairs. The nits are situated so near the base of the hairs that it is best to shave them to ensure a complete cure. The pediculus pubis will affect the whiskers, beard, moustache, eyelashes, and chest of hairy men, but never invades the clothes or even enters the head. It should be borne in mind that this affection, though usually caught during coitus, may be contracted in other ways.

The *treatment* which is commonly adopted is to rub in ung. hydrargyri, continuing the treatment as each fresh lot of nits is hatched. Occasionally, however, in delicate skins this produces a violent attack of eczema, rendered oftentimes all the more violent by the additional application of the ointment, under the impression that the extra irritation is caused by the pediculi and not by the ointment. No fear of such a disaster need be entertained if equal parts of ung. hydrarg. ammon. and lard are employed, or petroleum prepared as in the case of *P. capitis*. Much irritation may be avoided by sprinkling a little chloroform on the affected parts, and then washing off the

stupefied lice, after which the ointment, &c., may be trusted to prevent the nits from doing any further harm.

W. BRUCE CLARKE.

PELVIC ABSCESS.—Abscess may form in the pelvic cavity of a female subject as the result of several disorders, particulars of which are to be found in works upon obstetrics and diseases of women. Inflammation of the connective tissue of the pelvis, generally termed pelvic cellulitis or parametritis, is probably the most frequent cause of pelvic abscess. Pelvic peritonitis or perimetritis is a less frequent cause of the same complication.

Although specific discharges seldom, if ever, set up suppuration around the bladder and urethra in women, they may lead to pelvic cellulitis or peritonitis, and thus indirectly cause abscess. In such a case, the surgeon must lay more stress upon a history of child-bearing or abortion than on the recent or present existence of gonorrhœa in the same patient. For it is questionable whether gonorrhœa, in single women, is so frequent a primary cause of severe pelvic peritonitis as has been asserted; but it is a certainty that the same disease may set up pelvic peritonitis of the worst type if the patient be delivered, or have an abortion during its existence. Thus, in venereal out-patient practice in hospitals, a large proportion of sterile women with gonorrhœa may be watched for months, but pelvic peritonitis and pelvic cellulitis will not be found to be common among these cases. Let the surgeon turn to the gynecological department of the same hospital, and he will not fail to observe numerous cases of pelvic peritonitis and cellulitis, and not a few in the suppurative stage; nearly all the cases will be in married women who have had children or miscarried, and a history of gonorrhœal infection will, unfortunately, be found in a large proportion. Noegorath's theory of the frequent relation of gonorrhœa to sterility does not come within the scope of the present subject, but it should be noted that in many sterile cases there may have been an overlooked early abortion.

Carelessness in the use of the sound, and cutting operations about the cervix uteri, may be the cause of suppurative pelvic cellulitis or peritonitis. Here, again, the presence of gonorrhœa would greatly increase the dangers of these minor operations. The suppuration of a morbid but non-inflammatory deposit in the pelvic cavity is another cause of abscess. Under this

head must be included two very different conditions, pelvic hæmatocele and extra-uterine fetal cysts. The suppuration of a portion of ovarian cyst, adherent to the pelvic structures, is not infrequent, especially in the case of dermoid cysts. The abscesses set up by fetal and dermoid cysts often burst into adjacent cavities, especially the bladder and rectum, and seldom point above the groin.

Symptoms and Diagnosis.—The premonitory symptoms of suppuration are the same in the female pelvic structures as elsewhere. See ABSCESS. They are often masked or overlooked in this particular kind of abscess. Women may complain of feeling suddenly hot or suddenly cold when simple, non-suppurative, inflammation is spreading in the pelvic connective tissue or in the peritoneum, and sudden rises of temperature often occur under these circumstances. Nevertheless, rigors and rise of temperature will always give grave suspicion of abscess, when occurring in any of the diseases mentioned above as predisposing to suppuration. When these symptoms have occurred, the diagnosis of the abscess by touch is far from being easy. It is generally surrounded by a wall of indurated inflamed structures, so that until it has pointed and is about to burst, none of the characteristic fluctuation can be detected. Parametric abscess often forms in the hard irregular inflammatory deposit which rises out of the pelvis in bad cases of pelvic cellulitis. Dr. J. Matthews Duncan has shown how such abscesses may extend into the thigh, the iliac fossa, the psoas muscle, or even as high as the kidney. This must be taken into account when abscess is detected in those regions in any adult female, single or married; and the surgeon must not mistake persistent lumbar pain, due to the pelvic disease, for evidence of spinal caries. A tender fluctuating swelling presenting in Douglas's pouch or above Poupert's ligament, after general symptoms of suppuration, is, after all, the only trustworthy evidence of pelvic abscess.

The *diagnosis* of abscess from the two chief inflammatory pelvic diseases, in their earlier stages, can only be proximately effected by a very careful unravelling of the history of the individual case. In pelvic cellulitis or parametritis, abscess may form at any stage, sometimes very early, whilst, when once the disease in question has occurred, the patient may, many years after its onset, suffer from a 'residual abscess,' formed in or about the residues of former

inflammations. In pelvic peritonitis or perimetritis, abscess appears to present generally in Douglas's pouch. Fluctuation in that pouch, in cases of perimetritis, may indicate a collection, not of pus, but of serum ('serous perimetritis'). The sudden onset of pelvic hæmatocele distinguishes it from pelvic abscess, and the collection of effused blood tends to become harder and less painful, whilst the reverse will occur where abscess has formed. Nevertheless, diagnosis is often obscured in cases of suspected hæmatocele. The catamenial history must be taken into account when an extra-uterine foetal cyst is suspected; on the other hand, an abscess never begins with frequent attacks of metrorrhagia and crampy pains without fever. When a foetal cyst is diagnosed, and rigors set in, suspicion of its suppuration becomes very reasonable. When an ovarian tumour exists, it is often impossible to diagnose suppuration around, from suppuration within, its pelvic portion. Pelvic abscesses being fixed, may be thereby distinguished from distended Fallopian tubes and incipient ovarian tumours.

Prognosis.—The course of abscess, in cases of extra-uterine gestation and pelvic hæmatocele, is generally very irregular and uncertain; and it may be laid down as a rule, that pelvic abscess following pelvic cellulitis or pelvic peritonitis is a most troublesome disease, always tedious in its course, and never unattended by danger. The anatomical relations of the abscess prevent early or safe pointing, and, the abscess walls being rigid, especially in parametric cases, collapse is impossible, and fistulous tracks in the groin or genito-urinary passages may remain for years. The probability of a residual abscess, or of fresh acute attacks of suppurative inflammation behind the first abscess, is very strong. Rupture of the abscess into the peritoneal cavity is rare though not unknown. The abscess-cavity in an ordinary case, where the opening is external, may harbour septic material, with the usual disastrous results. Pelvic abscess most frequently opens in the groin, the rectum, or the vagina. This subject will be considered in connection with treatment. It frequently happens that, in the course of a pelvic abscess, there is a more or less temporary arrest of the formation of pus, whilst that already formed may partially dry up. It is clear that chronic abscess in this condition is a constant source of danger, when situated amongst the pelvic viscera, though far less serious in many other situations on the trunk or extremities. It may give rise to all the re-

sults which follow non-suppurative forms of pelvic inflammation. The inflammatory process may suddenly extend, fresh abscesses forming, or, still more frequently, fresh adhesions of viscera. We say fresh, since it is rare that any severe form of inflammatory disease of the pelvic peritoneum or cellular tissue is unattended, from the first, by such adhesions.

Abscess, from suppuration in or around an extra-uterine foetal cyst, places the patient in great danger from the risk of escape of pus into the peritoneum. It may burst into the vagina, and thus allow of the 'birth' of the relics of the foetus sometimes entire, more frequently piecemeal. The suppuration of the pelvic portion of an ovarian cyst is a subject that does not come entirely within the scope of this article. The suppurating cyst may rupture into the vagina or peritoneum, and always complicates the case most seriously.

Treatment.—Pelvic abscess is a disease which it is difficult to treat satisfactorily. The difficulty in ascertaining where the abscess will point, and the still greater difficulties due to the usual rigidity of the abscess-walls, are the chief sources of trouble in treatment. The commonest form of pelvic abscess is seen in cases of pelvic cellulitis after childbirth, and it generally bursts in the groin. When the complexity of the anatomical structures between the integument along Poupart's ligament and the pelvic connective tissue is remembered, it is not surprising that the pointing process is often tedious. The widespread induration, which can be felt over the region of the abscess, explains how impossible it must be for the abscess-wall to collapse with readiness. When symptoms occur indicating pelvic suppuration after childbirth, the surgeon must look out for any softening in the hard mass, which can generally be felt in one groin; but must not forget that the abscess may burst through the integuments over the iliac fossa, above the ilium, in the thigh, or near the anus. It has been known to find its way through the obturator or through the great sciatic foramen. Lastly, these 'parametric' abscesses may burst into the rectum or vagina. On the other hand, in pelvic peritonitis, from any cause whatever, abscesses tend to burst into the rectum or vagina: rarely into the general peritoneal cavity or the bladder.

Guided by these considerations, the surgeon must be watchful in cases of pelvic cellulitis, and test by gentle digital examination the relative softness of the

exudation in the direction of the groin and in the pelvic cavity. Bimanual palpation is sufficient for the purpose, and the uterine sound should be eschewed. When the abscess points in the groin it may be opened by a free incision, and the pus allowed to flow out. It is not advisable to press on the abscess from the vagina or from the abdominal walls, as there is an especial risk of admitting a quantity of air into the rigid-walled collection of pus. A drainage-tube is an absolute necessity, and the cavity should be frequently washed out with antiseptic solutions. Iodoform gauze pads make a good dressing. The process of closing is often much protracted.

When the abscess points into the rectum or vagina, the surgeon must not be eager to employ the aspirator. It is a dangerous instrument, though it still has the reputation of being safe for this purpose. Free incision and thorough drainage will be needed. It is impossible to employ full antiseptic precautions under these circumstances. Care must be taken that the tube be carefully fixed, and antiseptic solutions must be injected gently, lest some weak part of the abscess-wall be damaged; for abscesses in the direction of the rectum and vagina are often not so thick-walled as those pointing towards the groin. An iodoform bougie may advantageously be retained in the vagina during treatment, if the abscess have opened into that passage.

In cases of pelvic peritonitis the same treatment is needed; the abscess nearly always bursts into the rectum or vagina. When pelvic peritonitis occurs from no evident cause, such as childbirth, abortion—criminal or otherwise—or unsuccessful operations about the pelvic region, the surgeon must be prepared for surprises. On bursting of an abscess, foetal bones or masses of amorphous osseous tissue, hair, or sebaceous material, may escape with the pus. Independently of the general treatment of extra-uterine foetation and dermoid ovarian cysts, the surgeon's duty in such a case is to enlarge the opening very carefully and to extract the solid structures, which, after exposure of this kind, are more likely to set up complications than before. Antiseptic injections will then be very much needed. *See EXTRA-UTERINE FOETATION; OVIOTOMY.*

In conclusion, the surgeon, in treating any case of pelvic abscess, must never fail to remember that it represents other morbid conditions, which he must seriously take into account.

ALBAN DORAN.

PELVIC CELLULITIS.—This disease is termed 'parametritis' by several contemporary writers of high authority, chiefly from their objection to the word 'cellulitis' as unclassical. As the same writers, however, are those who rightly insist on the complete difference between this disease and 'perimetritis'—as they invariably term 'pelvic peritonitis'—it appears hardly advisable to employ terms so similar in sound, and therefore so liable to be confounded.

Pelvic cellulitis signifies inflammation of the cellular tissue of the female pelvis. Its pathology is that of cellulitis elsewhere, subject to local anatomical peculiarities. Hence, the surgeon must remember the relation of the fasciæ and peritoneum, and of the pelvic organs to the true cellular tissue of the pelvis. He should also bear in mind the anatomy of the lymphatic glands in the pelvis. The writer has repeatedly detected distinct enlargement of one of the obturator glands in the early stage of pelvic cellulitis. The enlarged gland may be felt by passing the finger up the lateral aspect of the vagina, then slipping it forwards along the tendinous origin of the levator ani muscle. When the anterior part of the attachment of that muscle is reached, the enlarged gland will be distinctly felt. A day or two later, should the disease have made progress, the gland will be embedded in inflammatory deposit, and its outline can no longer be defined.

Pelvic cellulitis is essentially a disease incidental to parturition. It is far less frequent in pregnancy, but is not rare under circumstances independent of the impregnated state. It generally arises in the cellular tissue around the cervix uteri. Pathologists often explain this fact by noting the abundance of this tissue in that region. The true reason is the frequency with which the cervix is exposed to injury involving its deep tissues, for such injury is probably the direct exciting cause of inflammation in the surrounding structure. Hence, damage to the cervix during parturition, the passage of a sound, or operative measures in its neighbourhood may all be causes of pelvic cellulitis. Septic material, entering a wound in the cervix, evidently produces similar effects to septic wounds in the neck or finger. The cervix is surrounded by a dense network of lymphatic vessels, as well as by cellular tissue. This explains the wide diffusion of the inflammatory process in the course of this disease. Cellulitis, beginning around the cervix, may certainly run its course without evidence of any complication involving the peritoneum.

When, however, it is set up in the very scanty cellular tissue between the body of the uterus and its peritoneal investment, it is hard to understand how the peritoneum can remain unaffected. Thus, it is frequently complicated with pelvic peritonitis, although that disease is probably caused, as a rule, by passage of septic material through the Fallopian tube into the peritoneal cavity. For the relation of gonorrhœa to pelvic inflammations, see PELVIC ABSCESS.

Symptoms.—Pelvic cellulitis almost invariably begins with those general symptoms observed in all other forms of cellulitis. Some women pay little heed to the early rigors and feverishness, which they attribute to sitting in a draught, or to a cold. It is certain that young subjects may continue to indulge in social pleasures involving active exercise, and that many older women will work hard for their families, until the disease has made great progress and produced prominent objective symptoms. The medical attendant will then be able to elicit little more history than that the patient has been recently confined, or has undergone some 'minor' gynecological operation, and that she has not felt quite well for a day or two. As a rule, however, there is much feverishness, and distinct rigors occur, with sharp pain in the pelvis. The pulse is rapid and softer than in pelvic peritonitis, and whilst the abdomen is less frequently tender than in that disease, vaginal examination gives far more pain. A hard immovable mass rapidly forms either on one side of the cervix, in front of it, or all round that part of the uterus. In all cases, it tends to spread laterally and upwards. This swelling, though not so circumscribed as a tumour, has boundaries which may be readily defined on bimanual palpation. In this respect it differs from pelvic peritonitis, where a distinct resistant surface is generally detected behind the cervix, yet no circumscribed swelling can be made out. For the diagnosis from hæmatocele see PELVIC HÆMATOCELE.

The hard mass of cellular tissue infiltrated with inflammatory products may project above the brim of the pelvis, so as to be plainly detected on pressure over the iliac fossæ, without introduction of the hand into the vagina. This condition can never occur in pelvic peritonitis. At this stage, suppuration or sloughing may occur. The uterus is firmly fixed in the pelvis, often from a very early stage. The disease tends to become chronic, especially if the

patient rise too soon after the more acute symptoms have subsided. In this case, indurated areas of cellular tissue remain, and render the patient subject to fresh attacks of inflammation.

Prognosis.—Pelvic cellulitis is seldom fatal. In the severe and sudden attacks which follow childbirth, the patient feeling very ill and anxious, will, as a rule, rest and obey advice. Hence, under such circumstances, complete recovery may occur in a few weeks, the indurated mass disappearing entirely. In sickly or careless subjects, abscess is very liable to form. The chronic forms are insidious, and often cause complications.

Treatment.—When the surgeon detects the indurated masses of infiltrated cellular tissue, he must carefully seek for evidence of suppuration. For the line of treatment to be followed if abscess form, the reader is referred to PELVIC ABSCESS. As long as there is no evidence of suppuration the patient must be left alone. Perfect rest in bed is absolutely necessary, and often proves in itself a complete remedy. Poulitices over the iliac fossæ and hypogastrium give great comfort. The rectum should be cleared of scybala by an enema, and an occasional saline purgative may be given, provided that evidence of peritoneal complications be absent. Above all, the patient must be kept in the recumbent posture for a week or two after the symptoms have disappeared.

ALBAN DORAN.

PELVIC HÆMATOCELE.—If blood escape from a pelvic organ it will flow in the direction of least resistance, and in this respect will imitate inflammatory exudations in the same region. As the inflammatory process is, however, very different from hæmorrhage, it is evident that the escape of blood into the cellular tissue of the pelvis cannot be precisely compared to inflammation of that tissue, which can offer great mechanical resistance to the blood; whereas its very substance is rapidly softened and otherwise altered by inflammation, so that it can no longer resist distension by exudations. Hence, hæmatoceles in the pelvic cellular tissue are rare, and cannot form large masses of semi-solid consistence; and many such masses, which once would have been considered as collections of coagula distending the cellular tissue, are really intra-peritoneal hæmatoceles.

In the pelvic peritoneum, as in the cellular tissue, hæmorrhage and inflammation must differ greatly. The former may be sudden, and then can go on freely,

with little mechanical check and imminent danger to the patient's life. When less violent or rapid, the blood will undergo the changes which always occur when that fluid escapes from its natural channels. The irritation of the fluid and its coagula, or, more likely, some morbid process existing previous to the hæmorrhage, and possibly its cause, sets up local peritonitis, and adhesions may form, cutting off the collection of blood from the rest of the peritoneal cavity. Lastly, the collection of blood may gradually disappear after undergoing well-known changes, or, under unfavourable conditions, it may become decomposed or excite suppuration in neighbouring parts. The surgeon should never overlook the fact that one of these unfavourable conditions may be uncalled-for surgical interference, or careless after-treatment when such interference may have been necessary.

Causes.—Any disease or accident, likely to cause hæmorrhage into the pelvis, may give rise to pelvic hæmatocele. During the process of ligature of the pedicle of a large ovarian cyst, a varix frequently forms on the proximal side, in the abundant cellular tissue found below the limits of the peritoneum in these cases, and it is highly probable that a true hæmatocele may form under these very circumstances. The writer has seen over a hundred cases where the proximal portion of the pedicle was found to be greatly distended with blood. No evil effects followed; hence it was impossible to prove, though reasonable to suspect, that in some of these cases the swelling was hæmatocele, and not simply varix. Extra-uterine foetation is the cause of the most serious form of pelvic hæmorrhage, and, when the bleeding is slow, a true pelvic hæmatocele may form.

The most frequent cause of pelvic hæmatocele is the rupture of some vessel, during the congestion of the pelvic viscera associated with the process of menstruation. Hence, the surgeon should never neglect to make most careful inquiries into the menstrual history of any case of solid or fluid deposit in the pelvis of a patient; and when a patient with such a deposit complains, before leading questions have been put to her, of an attack of severe pain during a menstrual period, the evidence in favour of hæmatocele is very strong. The source of the hæmorrhage is a much-disputed point, but it may arise from rupture of a vessel in the broad ligament, in the ovary itself, or under the mucous membrane of the Fallopian tube, or the tube may burst and bleed; lastly, most authorities main-

tain that the hæmorrhage may arise in the uterus and flow into the pelvic peritoneal cavity through the tubes.

Symptoms.—There is no disease that is occasionally so clear, and generally so obscure, as pelvic hæmatocele. A sudden attack of pain in the hypogastrium during a monthly period, followed by a swelling at the seat of pain, are the most characteristic symptoms. If the pain be preceded by a cessation of the menstrual flow, and succeeded by its reappearance for a day or two, the evidence of hæmatocele is still stronger. Distinct anæmia, with absence of fever for several hours or more after the onset of the attack, is also highly characteristic. The swelling, under favourable circumstances, will often become rapidly smaller, so as to leave little or no trace of its existence in a few weeks, and this without any history of escape of pus from the vagina, bladder, or rectum, or any symptoms of rupture of a cyst into the peritoneum. The surgeon must bear in mind this frequent course of a hæmatocele, for he is often called in some time after the acute symptoms have subsided. On the other hand, inflammatory changes may occur around the effused blood, and greatly obscure diagnosis. In the earlier stages, vaginal examination will often lead to the detection of a fluctuating swelling in Douglas's pouch or elsewhere in the pelvis; whilst, later, the swelling becomes firm and solid. This is often pointed out as the chief diagnostic sign, pelvic inflammatory exudations being hardest when most recent. But pelvic examination is not always easy at the onset of an attack of hæmatocele, nor does the surgeon generally see the case at that stage. As a rule, several of the symptoms above described will exist, but will be more or less masked, either by secondary complications or by a disease of which the hæmatocele is an effect.

Diagnosis.—The symptoms of pelvic abscess and pelvic cellulitis will be found in the articles on those diseases. Their onset is less sudden than the symptoms of hæmatocele; the phenomena of inflammation or suppuration exist from the first, and there is no necessary, though very often an accidental, connection with a menstrual period. The catamenial history is very important in diagnosis between simple hæmatocele and rupture of an extra-uterine foetal sac. See EXTRA-UTERINE FETATION. Retroversion of the pregnant uterus may produce sudden pain with shock, but bimanual palpation will show the true nature of this condition. When the effusion is chronic, it may be mistaken for old in-

inflammatory deposit, or even malignant infiltration, especially when the cervix uteri is lacerated and everted, and a sanious discharge flows from the uterine cavity. The physical characters of the swelling and the importance of the menstrual history have already been noted.

Prognosis.—When the early symptoms are very marked, the disease may be rapidly fatal, since the hæmorrhage is then considerable; and when they abate, it must be remembered that they may recur at the next period. A large proportion of typical cases recover, especially when rest has been enforced. The collection of blood may undergo suppuration or decomposition, producing characteristic symptoms.

Treatment.—It is certainly good surgery to leave most cases of pelvic hæmatocele alone, but there always remain some in which active treatment is necessary. When the surgeon is summoned directly the acute symptoms appear, the abdominal pain will induce him to explore the abdomen, and the swelling will be detected; and it need hardly be added that he must explore the pelvic cavity by bimanual palpation. The detection of a fluctuating swelling, almost invariably in Douglas's pouch, certainly could not induce him to puncture it. Perfect rest for several days must be enforced, opiates will in many cases prove beneficial, and ergot should be administered in small doses at intervals of six or eight hours. A good preparation of that drug for this purpose consists of half a drachm of the iron-muriated tincture, with twenty minims of rectified spirit, to be taken in a wine-glassful of water. It is less likely to decompose than the liquid extract freely dissolved in water, and thus keeps its strength for days. If the symptoms of internal hæmorrhage be very marked, the surgeon may, after full deliberation, be induced to take upon himself the grave responsibility of abdominal section, with a view of securing the bleeding vessels. Such a course is certainly justifiable if he have no experience in abdominal surgery; but must not be forgotten that to handle the uterine appendages, when they are not engaged, especially when they are embedded in coagula, is a far more difficult task than to remove an ovarian cyst. If the hæmorrhage be found to proceed from the ovary, that organ must be amputated, and when blood is seen flowing from a rent in one of the ovarian veins, that vein must be secured; but, as a rule, the hæmorrhage is best checked by removal of the uterine appendages on the affected side. No

operation of this kind should be attempted until there is strong evidence that the source of the hæmorrhage is not in the uterine cavity. See OÖPHORECTOMY.

When the case is more chronic, the patient must be careful to refrain from exertion during each period, when the bleeding may recommence. Should the swelling remain undiminished in size, it must not be interfered with without due deliberation. Indeed, it is best to leave it alone altogether, unless symptoms of suppuration or decomposition of the clot make their appearance. Abscess may form near a hæmatocele and acquire communications with it, ultimately bursting on a free surface, either in the rectum or in some part of the genito-urinary tract. When any such complication is suspected, the swelling may be opened in its most dependent portion. The aspirator is unadvisable; a large trocar is best for the purpose, and it is not safe to break down the clot with the finger, as thus adhesions may be torn, endangering the peritoneum and neighbouring organs. Should the abscess have burst, the aperture in the mucous membrane of the vagina or rectum must be cautiously enlarged, if the mixture of pus and coagula cannot escape freely. The vagina should be frequently washed out with antiseptic lotions, thrown up with gentleness and caution.

ALBAN DORAN.

PELVIS, Injuries of the.—These are contusions and fractures. *Contusions* of the pelvis are not different in effect from similar injuries in other parts of the body; therefore no special description of their symptoms or treatment is requisite. They sometimes cause considerable extravasation of blood. If this be subcutaneous it cannot be mistaken, and in most cases is speedily absorbed; but if absorption be tedious, aspiration and compression may be employed. If the extravasation be beneath the gluteal fascia it may be mistaken for an abscess, but the temperature chart of the patient will show whether acute suppuration is occurring or not. In doubtful cases, aspiration may be used to decide the nature of the case.

With respect to fractures, the pelvis may be regarded as a girdle of bone; for the articulations at the sacro-iliac synchondroses and the symphysis pubis are so close and rigid, that separation of these parts may be practically regarded and treated as fracture, although it is technically a dislocation. Each of the component bones of the pelvis may be fractured independently of the others.

FRACTURES OF THE OS INNOMINATUM.—The anterior and superior part of the ala of the ilium may be fractured by falls against some hard surface, or by severe blows, or by the patient being run over. If uncomplicated, it is not of much importance. The patient will experience pain on movement, especially in changing from the recumbent to the sitting, or from the sitting to the erect position, or in violent expiration, such as coughing, sneezing, &c. The local pain and the mobility of the fragment will indicate the nature of the injury. Rest in the recumbent posture, and the application of a well-adjusted pelvic belt, with the interposition of cotton-wool for the protection of the skin over bony prominences, will suffice for treatment.

In young persons, the epiphysis of the crista ili is sometimes partially detached by violent muscular efforts. The history of the case, the local pain, and the exclusion of all other possible causes, must serve as indications for the diagnosis of this rare accident. The treatment will be the same as for fracture of the ala of the ilium. The anterior superior and inferior spinous processes of the ilium are occasionally detached by violent action of the sartorius and rectus femoris muscles. The treatment will be rest in the recumbent posture. Probably some local but unimportant deformity will result.

FRACTURES OF THE ACETABULUM are attended with more serious consequences. Sometimes, a fall on the feet from a height will result in fracture of the upper margin of the acetabulum and dislocation of the femur on to the back of the ilium. The recurrence of the dislocation after reduction will indicate the nature of the injury, which must be treated, after reduction of the dislocation, by the application of a long splint and extension by a weight and pulley, as in fracture of the thigh. Permanent shortening of the limb will probably result.

Sometimes, the floor of the acetabulum is detached from the rest of the bone and driven into the pelvic basin. The head of the femur may be impacted in the opening. This injury may result from falls on the great trochanter or on the feet. If in such an accident the head of the femur be impacted, the shortening of the limb and the immobility when the patient has been anaesthetised might suggest, in the absence of any other cause, the nature of the injury. But if there be no impaction, a certain diagnosis would appear to be impossible. These cases are, however, very rare, and the general symptoms would indicate

the necessity of rest and, probably, of extension by weight and pulley.

The os innominatum may be fractured into its three component parts. This may be caused by a fall on the great trochanter, or possibly on the head. The writer has seen two instances of this fracture which appeared to have been caused by falls on the head. Since the base of the skull can certainly be fractured in consequence of a fall from some height upon the feet, it is not improbable that the innominate bone may be fractured by being forced against the femur, as well as by the femur being forced against it. To adopt Koenig's apt illustration, the head of a hammer can be driven on to the handle, or the same result may be obtained by striking the reverse end of the handle, vertically, against some resisting surface. This fracture of the innominate bone is usually complicated by other fatal injuries. If not, union may result, as museum specimens prove, which have subsequently been obtained from subjects who had previously sustained this injury. Permanent lameness would be inevitable. The diagnosis of the injury would be very difficult. Mobility of the fragments would render it certain, but the fragments are usually interlocked. The general symptoms would indicate rest and, probably, extension of the corresponding lower extremity, as the most suitable treatment.

The SACRUM may be fractured by blows, kicks, or falls from a height in a sitting posture. Such a lesion involves risk of inflammation of the membranes of the spinal cord, or of injury to the sacral nerves and paralysis of the parts supplied by them. The treatment would consist in rest in the horizontal position, with careful adjustment of pillows so as to prevent any pressure on the part. It occurs very rarely. The writer has seen one instance of it. A sailor had fallen from a mast on deck, in a sitting posture, and, unfortunately for him, on a cocoa-nut. His sacrum was extensively comminuted. The accident happened at sea. Several months later he was admitted into the London Hospital under Mr. Curling. He had several fistulae over the sacrum and in the perineum, leading to necrosed bone, and, as faeces escaped by many of these, the rectum had certainly been implicated in the injury. The condition of the patient prevented any attempt at operative interference, and he was discharged as incurable.

The COCCYX may be fractured by similar causes or in parturition. The patient will experience pain in movement and during

lefecation. The introduction of a finger into the rectum will detect any malposition of the fragment. When this has been reduced, the patient must be kept at rest until union has taken place.

The PELVIS, regarded as a bony girdle, may be fractured in consequence of severe compression, as by the passage across it of the wheel of a heavily-laden vehicle, or in some railway or similar accident. Solution of continuity usually occurs at both sacro-iliac synchondroses, the symphysis pubis, and the horizontal rami of both pubic bones, immediately internal to the ilio-pectineal eminences. The ascending rami of the ilia are also often broken. In some cases the force acts diagonally, so that only one synchondrosis is torn open, and the horizontal ramus of the opposite pubic bone fractured at the usual place. More rarely, the injury may be limited to the bodies and crests of both pubic bones. This may possibly result from spasmodic contraction of the abdominal muscles, as well as from direct violence. The history of the case, the inability of the patient to walk, and pain on attempting to move the lower extremities will indicate the nature of the injury. Slight pressure on both halves of the pelvis may detect mobility, or cause great pain to the patient. Absence of both these signs, and especially of the latter, might encourage the surgeon to hope that it was a case of contusion rather than fracture. Minute investigation as to the extent of the injury is not advisable. The injury, uncomplicated, and if not immediately fatal from shock, would not be of much greater importance than other severe fractures. But it is almost always complicated with serious visceral lesions.

Attention should at once be directed to the condition of the bladder and urethra. A full-sized silver catheter should be cautiously introduced, if possible, into the bladder and, if the urine be tinged with blood, should be tied in, and connected with a receiver containing carbolised water. An exhausted india-rubber tube, so that the urine may flow at once from the bladder to the receiver. But if the urethra be torn across, or if the bladder be ruptured, the appropriate treatment for these lesions must be adopted. See BLADDER, Rupture of the; URETHRA, Injuries of the. Laceration of the liver, spleen, kidneys, or intestines, injuries to the thorax, or fractures of the bones of the upper and lower extremities, frequent complications. The prognosis is very unfavourable, and the treatment, so far as the fracture of the pelvis is concerned,

will consist in rest, with support from suitably adjusted pillows.

JEREMIAH MCCARTHY.

PEMPHIGUS (*Synon.* Pompholyx).—

A rare disease of the skin, characterised by the appearance of bullæ in successive crops on any part of the cutaneous surface, and occasionally on the adjacent mucous membranes. Nothing is known with certainty as to its causation; it is met with in all climates and at all seasons of the year, is more frequent in children than in adults, and is perhaps a little commoner in men than in women; it is not contagious. The persons attacked by it are sometimes exhausted by chronic diseases of various kinds, or by insufficient food and bad hygienic conditions, but it often occurs in those whose general health appears to be perfect; it is sometimes congenital, or nearly so, and has been observed to be hereditary on rare occasions. It is probable that the nervous system is directly or indirectly implicated, and evidence is accumulating which favours this view; thus mental suffering, hysteria, sciatica, epilepsy, and insanity have been noted as antecedents, and a case of herpes zoster, which followed nervous injury, has been observed to become transformed into generalised pemphigus (pemphigus neuriticus). Pregnancy and parturition have often been noted as associated conditions; and, further, pyæmia, chronic Bright's disease, and other states in which toxic matters are absorbed into or retained in the blood, have been considered as causes. It is probable that, in many of the above instances, the bullous eruption which occurs should not be admitted as true pemphigus. The blebs which appear in leprosy and syphilis should certainly be excluded. See *Herpes Gestationis* and *Herpes Iris* under HERPES; *Erythema Exudativum*, &c., under ERYTHEMA.

Pathologically, the disease may be placed among angioneuroses of the skin, a loss of tone of the blood-vessels, with more or less inflammatory disturbance, being accompanied or immediately followed by a rapid effusion of serum which raises the epidermis in a blister; hence the bullæ of true pemphigus, being due to a sudden epidermic cleavage, are unilocular, and their roof is formed by the whole epidermis, the floor consisting of the corpus papillare of the corium with a few adherent remains of epidermis, chiefly of the deepest (cubical) layer. More rarely, the splitting takes place immediately below the stratum granulosum.

the parts above which then form the roof. This form of bulla, which is not due to inflammatory changes in the epidermis, is thought to depend on a diminished power of resistance to pressure by fluids in the cells of the stratum spinosum (Malpighii), and the whole process has received the name *Acantholysis*. The bullæ which form as a result of inflammation arise in a different manner: by gradual changes in the cells of the rete, leading to vacuolation and vesiculation of individual cells, the vesicles gradually enlarge and become confluent with their neighbours, so as ultimately to give rise to irregularly loculated large cavities containing serum; in short, an inflammatory bulla is no more than an accidentally gigantic vesicle. The contents of the bullæ of pemphigus are serum, with more or less admixture of coloured corpuscles and leucocytes; the fluid contains a trace of urea, and its reaction is at first neutral and subsequently alkaline. Necropsies of pemphigus have revealed no constant visceral lesions; but, recently, sclerotic changes in the spinal cord, and degeneration of the peripheral nerves at the seat of eruption, have been noted.

The greatest variability in the size, aspect, and distribution of the bullæ, in the duration of the disease, and in the severity of the symptoms, is characteristic of pemphigus, and hence authors have overloaded medical nomenclature with a superabundance of terms. It is not necessary to recognise more than two forms, pemphigus vulgaris and *P. foliaceus*; these are well marked, but the multitude of other names only deserve incidental mention as subvarieties.

1. PEMPHIGUS VULGARIS.—As already stated, the bullæ appear in successive crops, and may arise upon any part of the surface of the skin; they are perhaps commonest on the limbs, when they are roughly symmetrical. They are developed either upon reddened discoid spots or, more commonly, upon normal skin, and either retain their original size or grow, and sometimes become confluent. An outbreak of blebs is sometimes associated with pale red spots and wheals, which die away without giving rise to bullæ. A fully developed bulla is characterised by a rounded or oval shape, which becomes irregular when confluence has occurred; its size varies from that of a pea to a hen's egg or more; the base is surrounded by a faint and narrow erythematous zone; the walls are tense and shining, and the whole blister projects considerably above the surface, sometimes as much as an inch. The contents are at first transparent and

colourless, turning to citrine yellow; later, they become turbid and milky from admixture of pus-corpuscles; sometimes the colour varies from pale cherry to dark red, owing to admixture of blood (*P. hæmorrhagicus*), not necessarily in severe cases. In about three days to a week a bulla has either gradually shrivelled and dried up without rupture, or, less frequently, it has burst; in either case, a thin crust of old epidermis with dried exudation, and blood, if present, occupies its site, and after its detachment leaves a bluish-red macula corresponding to the base of the bleb; this is usually completely covered with young epidermis, and gradually fades away after becoming slightly pigmented. The bullæ appearing simultaneously vary in number from a few to a hundred or more, and may be distributed irregularly over a wide surface (*P. disseminatus*) or grouped (*P. confertus*). In rare cases a central bulla is surrounded by a more or less distinct ring of others (*P. circinatus*), and irregular serpentine figures may be produced by confluence (*P. gyratus*, *serpiginosus*); occasionally only a single bulla of large size appears at a time (*P. solitarius*). It is usual for fresh bullæ to make their appearance before the crusts and maculæ due to the previous outbreak have faded; therefore, in a characteristic case, stains, crusts, and blisters are present at the same time.

The interval separating the outbreaks is variable; sometimes, it is so considerable that an incautious observer may conclude the disease to be at an end, and at others crop after crop appears with barely appreciable intermission (*P. diutinus*). The constitutional symptoms vary with the extent of skin affected, the frequency of the outbreaks, and the duration of the disease. An outbreak of some severity begins with shivering, malaise, and fever, the rise of temperature being sometimes considerable but usually very moderate and of short duration; in mild cases the temperature is normal (*P. apyreticus*); during the continuance of the eruption, thirst, loss of appetite, and above all loss of sleep, are prominent symptoms, the latter being due to the itching, tingling, or burning, which are more or less marked. Itching is sometimes very severe. The bullæ are then destroyed by scratching, leaving excoriations. There is much associated urticaria and brown pigmentation, and eczema may appear as a complication.

In favourable cases, the disease may at an end in from two to six months, the bullæ becoming fewer and fewer with each

attack, and finally ceasing to be produced. The patient may then remain free for the rest of life, or fresh attacks may occur after many months or even years. In children, the whole process is more active and rapid and the fever higher, so that in some cases an end is reached in from two to three weeks (*P. acutus*, *febrilis*). In one or two instances a similar rapid course has been noticed in adults, but in the vast majority the disease is chronic. In rare cases, the successive crops of bullæ make their appearance in the same situations on each occasion (*P. localis*); they are then few in number, and are chiefly limited to the backs of the hands and feet and the extensor surfaces of the arms and legs, very much in the positions of psoriasis. In the writer's experience such cases are continental or nearly so, and extremely chronic, lasting for many years in spite of treatment; they are further characterised by the development of traumatic bullæ, a blow or other injury being followed by the appearance of a bleb, which is often hæmorrhagic. Both in these and in ordinary cases in which the eruption appears on the hands and feet, the nails often become affected in a characteristic manner. Apparently a bulla forms immediately under the nail, which becomes detached from the matrix, and of a dead white colour; it is ultimately shed, and the new nail is rough, irregular, and badly developed. Severe cases of pemphigus are characterised by a copious eruption, large size and confluence of the blebs, severe itching and burning, and very short remissions between the outbreaks; exhaustion and a fatal result may follow, although this is fortunately by no means invariable. The gravest cases are marked, in addition, by rupture of the bullæ, leaving excoriated or ulcerated surfaces (*P. alignus*) on which sloughs may form (*P. ingranosus*). Cases of this kind are extremely rare. When the mucous membrane of the mouth is attacked, bullæ cannot be recognised on inspection, as they rupture once, and the epithelium is soon detached in white flakes, under which a rounded excoriated spot is left. The process may extend to the pharynx and cause much difficulty and pain in swallowing, increasing the gravity of the prognosis. The mucous membrane of the conjunctiva and vagina may also be affected.

2. PEMPHIGUS FOLIACEUS.—This exceedingly rare affection is distinguished by the imperfect development of the bullæ, which are flaccid, contain a small quantity of thin serous fluid, and rupture with the greatest

ease; the adjoining epidermis becomes undermined and loosened, so that detachment occurs over a considerable area. The affected cuticle separates from the skin incompletely, and becomes shrivelled and rolled up at the edges, presenting an appearance which has been likened to flaky pie-crust. The subjacent corium is red and excoriated, the fluid oozing from its surface drying up into thin varnish-like crusts, under which a new epidermic layer has no time to consolidate, as it is at once again detached by a continuance of the process as fast as it is formed, and has then not sufficient power of resistance to form a bleb, but is shed as a thin scale. The process gradually extends until the greater part, or even the whole of the skin, is implicated. The surface then shows no bullæ, but is traversed by fine cracks, between which there are thin, flaky, more or less adherent crusts or raw oozing spots, and a nauseous odour exhales from the skin; the hair falls off largely, the eyelids become ectropic, and the nails thin and brittle. The patient loses appetite, suffers considerable pain, especially on movement, and gradually becomes emaciated and cachectic. Fever, which is slight at first, becomes gradually continuous, exhaustion supervenes (more rapidly when the throat is affected), diarrhoea may set in, and a fatal termination usually results. The disease may appear as such, or may develop from a long-continued pemphigus vulgaris, and is always exceedingly chronic, usually lasting many years. Although the prognosis is extremely grave, occasional instances of recovery have occurred.

Diagnosis.—The diagnosis of pemphigus does not depend upon the recognition of bullæ, which may form under a great variety of conditions, but upon the fact that they are chronically recurrent, appearing in successive crops, and that the great majority arise upon normal skin. If this be borne in mind, there will be no difficulty in distinguishing the disease from bullous urticaria, vesicating erythema, erythema (herpes) iris, and erysipelas. Bullæ may occur in scabies and in eczema, but the history and concomitant lesions of these affections are such as to render the diagnosis easy. In anæsthetic leprosy the bullæ are merely part of a constitutional disorder, with well-marked symptoms of its own, while syphilitic bullæ dry up into thick crusts, covering an ulcerated surface. The blisters which are due to friction, as from rowing or from ill-fitting boots, and those which arise from burns and scalds,

need barely be alluded to, while those which are produced by the fraudulent application of blisters and irritants to the skin are soon detected, in a suspicious case, by isolation and watching. Pemphigus foliaceus, after bullæ have ceased to be produced, may bear a close resemblance to general eczema rubrum, from which, however, it differs in the history, in the character of the fluid secreted, which is much thinner in pemphigus and does not stiffen linen, and in the greater severity of the constitutional symptoms. Some cases of pityriasis rubra (exfoliative dermatitis), and even of nearly universal psoriasis with flaky desquamation, have a very similar appearance; but, again, the history, the absence of bullæ at any previous period, the dryness of the surface exposed, and the much more profuse and easy detachment of thinner paper-like scales, will be sufficient distinctions.

Treatment.—The treatment of pemphigus differs according to the stage of the disease. When there is high fever, the patient should be kept in bed and the strength supported by fluid and nutritious food, with stimulants if necessary; a saline mixture with a small dose of antimonial wine (℥v. to x.) may be at first administered, but should not be long continued, to avoid depression; as the temperature falls quinine should be given, or it may be employed from the first; opium, to allay irritation and procure sleep, is a valuable remedy. As soon as a normal temperature is reached, arsenic should be begun and steadily continued. Although it is not curative in all cases, there can be no doubt that it gives good results in the great majority, if persevered in for a long time, and in full doses—say ℥x. of liquor arsenicalis three times a day, gradually reached; even larger doses may be given if it does not disagree, especially in combination with a little opium. When the patients are emaciated and anæmic, cod-liver oil and iron should be always employed, the latter with quinine as a rule. The local treatment is very similar to that employed for a burn—viz. the application of linimentum calcis on rags and envelopment of the parts in cotton-wool. A carbolic lotion or other anti-pruritic may be used when there is much itching, but the copious application of a dusting powder of starch and oxide of zinc, or of oleate of zinc, is to be preferred, as it is less troublesome and equally soothing. If the bullæ are closely packed, they may be pricked as soon as they appear, to relieve tension, and this should also be done if they show a tendency to spontaneous

rupture; but in ordinary cases no such interference will be necessary. The thin crusts, which form by the desiccation of the blebs and their contents, should not be detached, but allowed to come away spontaneously. If any excoriated surface be left, it should be protected by zinc ointment, or some more stimulating remedy may be applied if it does not heal readily. Very small bullæ may be sometimes checked in their growth or caused to abort, by being painted over with a solution of nitrate of silver in spirit of nitrous ether (gr. xv. to fʒj.) as soon as they make their appearance. When the mucous membrane of the mouth and pharynx is affected, a mouth-wash of chlorate of potash should be used, or the parts may be painted with honey of borax; if the affection is so severe as seriously to interfere with swallowing, the employment of nutrient enemata may be necessary for a time. The treatment of pemphigus foliaceus is unsatisfactory; quinine and arsenic may prove serviceable, but nearly always nothing can be done beyond supporting the patient's strength by good food and stimulants, and the employment of local palliative measures, among which the chief is the continuous warm or tepid bath; in this patients may be kept for months with comfort and advantage. JOHN CAVAFY.

PENIS, Amputation of the.—This operation may be performed by the écraseur, by the galvanic cautery, or by the knife. The use of the écraseur presents little advantage, and can only be advised in exceptional cases, when there is reason to expect a tendency to severe hæmorrhage. The galvanic cautery, when it can be had, is a most effective instrument for this operation, care being taken not to use the wire at too great a heat, or to divide the tissues too rapidly, as in either case hæmorrhage is likely to occur. When the amputation is completed, the urethra should be slit up for about half an inch with a pair of fine blunt-pointed scissors, and the edges attached by fine silk or catgut sutures to the skin and corpora cavernosa.

By far the most common method of amputating the penis is, however, with the knife. The old plan of removing the organ by a single sweep of the knife, and then slitting up and securing the edges of the urethra, has certainly the advantages of great simplicity and rapidity of performance, and in some cases, where the extension of the disease requires that the amputation should be performed as high up as possible, it is still to be recommended. But an im-

provement has been made in the operation with the object of securing the projection of the urethra beyond the stump, and thus avoiding the exceedingly troublesome retraction of the passage, which was not infrequently the result of the old operation. The steps of this operation are as follows: A tape is first firmly tied round the root of the penis, or Clover's clamp is applied at the same spot, by which means the operation is rendered bloodless. The penis is then drawn well forward by the left hand, care being taken not to overdo this, and thus leave too little skin to cover the stump. The next step in the operation is so to cut through the corpora cavernosa and the corpus spongiosum as to leave the latter, with the urethra, projecting half an inch beyond the former. This may be effected in two ways. First, by introducing a narrow straight bistoury between the corpora cavernosa and the corpus spongiosum, turning the edge of the knife upwards, and dividing the corpora cavernosa by a single sweep. The corpus spongiosum is then cut through by a downward sweep of the knife, half an inch nearer the glans. The other method, which is perhaps on the whole the easier, is as follows:—A full-sized catheter is introduced in order to define accurately the position of the urethra. A circular incision is then made through the skin only. The corpora cavernosa are next divided from above downwards, care being taken not to wound the corpus spongiosum. This accident will be prevented by the presence of the catheter acting as a landmark. The catheter is now withdrawn, and the corpus spongiosum, being put well on the stretch, is divided half an inch lower down.

Whichever method is adopted, the operation is completed by slitting up the urethra on the dorsal aspect, its lower edge being stitched to the skin below, and the upper portion to the corpora cavernosa. Fine curved needles in a needle-holder will be found most convenient, and very fine silk or catgut for the sutures. Before the tape or clamp is loosened, careful search should be made for the open mouths of all vessels. The arteries of the corpora cavernosa, the dorsal arteries, and the artery of the septum may generally be seen and at once secured. The pressure is then taken off, and any further bleeding points secured. The surface of the wound should be well dusted over with iodoform, and the parts dressed with lint steeped in a 1-40 solution of carbolic oil. The whole should be covered by a wad of tenax, secured in its

place by a T-bandage. The after-treatment is of the simplest: for the first few days care should be taken to prevent the urine, as much as possible, from passing over the raw surface of the wounds. The free use of iodoform, or an ointment made with iodoform, eucalyptus, and vaseline, is the best dressing. The fine sutures that have been inserted may be left to themselves.

It occasionally happens that the disease has so far advanced as to necessitate a more severe and complicated operation than either of those already described. In fact, it may be needful to remove the entire penis, including the attachment of the crura to the pubic arch. This operation, suggested by Mr. A. Pearce Gould, is thus performed. The patient being placed in the lithotomy position, an incision is made with a scalpel along the whole length of the raphé of the scrotum. Then, with the finger and the handle of the scalpel, the interspace between the two halves of the scrotum is separated down to the corpus spongiosum. A catheter is then passed down to the triangular ligament, serving as a guide for the passage of a knife between the corpora cavernosa and the corpus spongiosum. The catheter is now withdrawn, and the corpus spongiosum with the urethra is cut through.

The next step is to complete the separation of the urethra from the penis, and to carry the separation as far back as the triangular ligament. The removal of the penis is then effected by prolonging the incision, first made in the median line, round the root of the penis, dividing the suspensory ligament, and exposing the insertions of the crura. These attachments are separated from the pubic arch by a periosteal elevator. The orifice of the urethra is then slit up for half an inch, and its edges stitched with fine sutures to the skin at the posterior extremity of the scrotal incision. The rest of that incision, after all vessels have been secured, is then brought together with sutures, ample means of drainage being afforded. The result of this operation is that the urethral orifice is kept behind the scrotum, and the urine is prevented from dribbling over the skin of the surrounding parts.

PAUL SWAIN.

PENIS, Diseases of the.—For congenital malformations, see *Epispadias* under *Ectopia Vesicæ*; *Hypospadias*; *Phimosis*.

Cancer of the penis is for the most part epithelial in its character. Cases of carcinoma of the corpora cavernosa are occasionally met with, but very rarely. Epithelioma of the penis assumes one of two

forms. It may appear as a flat, tubercular mass, with a hardened base, situated on the glans or in the sulcus formed by the junction of the glans with the prepuce, or on the inner surface of the prepuce itself. It may also commence in the urethra. After a time the surface of the tubercle cracks, and exudes a fetid serous discharge. Ulceration now sets in, spreading rapidly upwards on to the penis, and thence, if the disease is not dealt with, to the scrotum and perineum. The base of this ulceration is greyish in colour and uneven, the edges being frequently everted. The other form of epithelioma assumes the character of a warty growth, and is, in fact, in its early stages, somewhat difficult to distinguish from the ordinary warts which are so frequently found on and around the glans and beneath the prepuce. The presence of a hard base, of ulceration with its attendant fetid discharge, and a tendency to hæmorrhage at the slightest touch, will leave little doubt as to the malignancy of the disease.

Another confirmatory symptom will be the enlargement of the glands in the groin. The rapidity with which the glands are affected varies with the situation of the original disease. If the epithelioma is situated on the corona glandis or beneath the prepuce, the moisture of the parts seems to favour the progress of ulceration, and, under these circumstances, the glands become more rapidly involved in the disease. On the other hand, an epithelioma on a more exposed part of the penis will affect the glands with less rapidity. One other difficulty of diagnosis may occur—viz: whether, in its earlier stage, the disease may not be simply the induration of a syphilitic sore. Doubt as to this, however, cannot long remain. The history of the case, and the failure to obtain improvement under specific treatment, will reveal the true nature of the case. The age, too, of the patient will be an important aid to diagnosis. Epithelioma of the penis is seldom found before the age of forty-five, and from that to seventy is the period of life when it more usually occurs.

Causes.—It is asserted that congenital phimosis is a predisposing cause of epithelioma, owing to the irritating effects of the retained secretions. The fact that the Jewish community is peculiarly free from this disease seems to favour the statement. Venereal warts, chancres which remain long unhealed and are subject to much irritation, the induration in the scar of an old chancre, may each and all of them lead to epithelioma. Injuries to the penis, espe-

cially laceration of the frænum, may also be the starting-point of the disease.

Treatment.—In few diseases is the policy of delay more to be deprecated than in epithelioma of the penis. As soon as the condition comes under notice, even if there is considerable doubt as to its real character, removal of the disease should be at once undertaken. In the case of warty growths, they should be destroyed with nitric acid, or the portion of skin from which they sprout should be excised with the knife. So, too, the tubercular form of the disease should be freely excised, provided the surrounding tissues be not too infiltrated. If the patient is the subject of phimosis, the prepuce should be at once slit up and the diseased surface exposed. *See PHIMOSIS.* Careful search for affected glands should be made, with a view to excision. In fact, it is of the utmost importance to deal with these glands at the earliest possible period. They early become so infiltrated with the disease and matted together that a clean removal is next to impossible, and extensive ulceration of the skin over them soon follows. When the local disease is beyond the chance of removal, amputation of the penis becomes needful, the division of the organ being made as far as possible from the site of the growth, and in advanced cases it may even be needful to remove the entire organ. *See PENIS, Amputation of the.*

Tumours of the Penis.—Fatty, nævoid, sebaceous, and fibroid tumours are occasionally met with on the penis, and require no particular description. In the case of the last, the question of recurrence should be considered. Mr. Beck has recorded a case in which he removed a fibrous tumour from the base of the glans penis. It recurred after two years, necessitating the amputation of the organ. A condition of preputial hypertrophy allied to elephantiasis is occasionally met with. Its treatment consists in the free removal of the redundant tissue.

Inflammation of the Corpora Cavernosa.—There sometimes occurs, in men of middle age, a localised, chronic enlargement in the sheath or erectile tissue of one or both corpora cavernosa. Mr. Prescott Hewett has described the condition in the history of a case recorded in the *Clin. Soc. Trans.* vol. vi.: 'In the corpus cavernosum were four nodules, three on the left side and one on the right, varying in size from a pea to that of a French bean; they were perfectly circumscribed, hard to the touch, knot-like, and painless when handled.' These cases seem to be

associated with the gouty diathesis, and occasionally may be traced to some slight injury. They are, in point of fact, cases of phlebitis. There is a general concurrence of opinion that little or no treatment is called for. Thrombosis of the dorsal vein is also met with under similar circumstances, and gradually disappears spontaneously.

Gangrene of the Penis.—Gangrene of the penis is generally the result of some acute inflammatory process. Acute inflammation of the prepuce following on gonorrhoea or chancre, the constriction of a paraphimosis, or the more immediate effect of a ring or ligature placed round the organ, may be the exciting causes. It is generally met with in patients whose health is broken down, and is of the moist variety, though occasionally dry gangrene follows an attack of fever. The treatment should be directed first to remove all constriction, by slitting up the prepuce in phimosis, and relieving the constricting band in paraphimosis. See PHIMOSIS; PARAPHIMOSIS. Then, if needful, free incisions should be made into the substance of the penis, and warm applications be continuously employed. Meanwhile, the general condition would require a stimulating and nutritious diet, with the administration of quinine and opium freely. As the time for the separation of the slough approaches, hæmorrhage not infrequently takes place, and, it is needless to say, is but ill borne by the patient already enfeebled by disease. During the process of cure, the contraction of the parts may so affect the urethra as to require attention. It should be slit up for half an inch, and stitched to the neighbouring skin, as directed for amputation of the penis.

Warts on the Penis.—The presence of warty growths on the penis is not infrequent, as the result of venereal infection or want of cleanliness. They are found on the skin outside the prepuce, fringing its orifice, on the mucous membrane between the skin and the glans, on the glans itself at the orifice of the urethra, and even within that canal. They are contagious. The most effectual method of treatment is removal with the scissors. The bleeding is sometimes rather free, but easily arrested by the use of very hot water and compression by strips of dry lint. In less severe cases, simply powdering over with calomel or oxide of zinc, with strict attention to cleanliness, will effect a cure.

Herpes is found on the prepuce and corona glandis as the result of local irritation or gastric disturbance. See *Herpes Progenitalis* under HERPES. PAUL SWAIN.

PERFORATING ULCER.—This affection is not exactly an ulcer. It is usually met with as a sinus-like aperture on the plantar surface of the foot, the sinus, if of any duration, leading down to dead bone. The opening is most frequently single, and situated over the metatarso-phalangeal joint of the great toe; but two or three openings may be met with—e.g. over the heads of the fourth and fifth metatarsal bones. Both feet may be affected. The orifice of the sinus usually gives vent to but slight discharge, is surmounted by but few granulations, is situated in what has been a corn, and surrounded by a flattened whitish-yellow area of greatly thickened epidermis. In addition to necrosed and fifth metatarsal bones, the subjacent joint may be affected, together with other articulations not in direct communication with the sinus. The tissues surrounding the sinus are usually not sensitive, and loss of sensation may be detected over the areas of one or more of the cutaneous nerves of the foot or leg. This anæsthesia may be accompanied by profuse and fetid sweating. More rarely anæsthesia is not observed, but cutaneous hyperæsthesia is present in the leg and foot. But, though the surrounding tissues may be insensitive, the patient is usually crippled by the great pain experienced in walking; he is furthermore liable to attacks of erysipelas and eczema.

Pathology.—In a large number of cases of perforating ulcer some degenerative nerve-lesions may be expected to be at the root of the matter. How many such lesions may cause perforating ulcer is not known; nor, in the case of those which are recognised, is their connection with the ulcer exactly understood. At present we may divide such nerve-lesions into two main classes—peripheral and central. Thus, in some the tibial nerves have been found much thickened with addition of connective tissue in the peri- and endo-neurium, and with multiplication of nuclei. Near the ulcer the ultimate nerve-fibrils are nearly obliterated, and farther from it the smaller fibres, which some authors consider to be sensory and nutrient, are found diminished in number.

In other cases the degeneration would appear to be central. The most interesting of these are the cases where patients with perforating ulcer are found to suffer from the lightning pains and anæsthesia in the lower limbs, the gastric and intestinal crises, the deficient motor co-ordination, and the diminished patellar reflex of locomotor ataxia. Perforating ulcer usually appears in the later stages of this disease; more rarely, it is noticed long before the locomotor

troubles. As this subject becomes better known, it may be expected that this disease may be proved to be associated with other lesions of the cord, spinal ganglia, or nerves, or with compression and laceration of large nerve-trunks. But, as yet, perforating ulcer is involved in much obscurity, and it is greatly to be desired that practitioners who may meet with cases should record them carefully, and, at every possible opportunity of amputation or post-mortem examination, preserve the foot with the nerves and spinal cord for examination.

Treatment.—Long-continued rest, and removal of the diseased bone, may, and often do, bring about a cure; but this is only temporary, the disease returning even after two or three years. When once the condition is declared—i.e. when one or more perforating ulcers with any anæsthesia are present—amputation of the foot should be resorted to. As it is often the terminal portions of the tibial nerves which are chiefly affected, Syme's amputation will in many cases remove the disease; if this recur in the stump, Teale's amputation, sawing the bone in the middle of the tibia, or amputation by lateral flaps through the tubercle of this bone, must be resorted to. Where the patient refuses amputation, or where this step is contra-indicated, imperfect rest and relief from pain will be secured by using a knee-rest and a well-padded shoe.

W. H. A. JACOBSON.

PERICARDIUM, Wounds of the.—These wounds may be produced by an external penetrating agent, or by the rough end of a fractured rib or sternum. They seldom occur alone, being generally associated with wounds of the heart, or of some important organ in the mediastina, such as the internal mammary artery, the œsophagus, &c. In those rare cases in which this membrane is alone wounded, the diagnosis can scarcely be satisfactorily established at first. The signs will be those of pericarditis—viz. increased precordial dulness, the pericardiac to-and-fro friction-sound, a small hurried pulse, and generally considerable dyspnœa. The pericardiac friction-sound may become lost if the precordial dulness increases much in extent. This is due to the effusion of blood, serum, or pus within the pericardium; should the case go on favourably, the sound may be heard again after some days from the gradual absorption of these products.

The indications for treatment will be similar to those for wounds of the other thoracic viscera. At first, it will most pro-

bably be doubtful whether the pericardium is alone wounded. But as the line of treatment is practically the same, this will not be of any great consequence. These indications will be treated of under HEART, Rupture and Wounds of the.

It may, however, be said here, that there is one condition of uncomplicated wound of the pericardium, in which special treatment is required. The pericardium may become over-distended by fluid, so much interfering with the heart's action as to call for some treatment for its relief. This may be found in tapping. A previous puncture with a subcutaneous injecting syringe having been made, and fluid drawn off from the pericardium by its aid, the bulk of the fluid may be withdrawn either by the aspirating needle and syringe, or by free incision (according to the nature of the fluid, whether serous or purulent), in the fourth or fifth intercostal space. In the latter case a drainage-tube should be used, the treatment of the wound being conducted with antiseptic details. See *Paracentesis Pericardii* under PARACENTESIS. The prognosis, however, in such cases is exceedingly grave. Comparatively few cases recover, especially where pus is found in the pericardium. In such cases, post-mortem examination generally reveals more or less old blood-clot still existing in the pericardiac cavity, and a certain amount of adhesion between the surfaces of the heart and pericardium.

H. G. HOWSE.

PERIMETRY.—Besides determining the visual acuity (see VISUAL ACUITY), by which we obtain information as to the state of functional perfection of the macula lutea, it is often necessary to ascertain whether the functions of the whole extent of the retina are normal or not. This examination of the 'field of vision' is sometimes called 'perimetry,' and is most accurately made by the aid of an apparatus called a perimeter.

Abnormalities may exist at any part of the field of vision, which may have merely defects in acuity or exhibit breaches in continuity. The interruptions in continuity may be both regular and irregular. The regular manifest themselves by some limitation of the normal extent in one or more particular or, it may be, in all directions; the irregular breaches are more or less blind portions surrounded by normal, or relatively normal, portions of the field of vision. To these the name of 'scotomata' has been given. To make an accurate examination of the field of vision it is neces-

sary to make use of some sort of perimeter. For rough estimates it is often sufficient for the observer to place himself opposite the patient, who, if it be the right eye that is to be examined, is instructed to fix steadily the observer's left, if the left his right eye. If the observer at the same time maintains a steady fixation of the patient's eye, the respective fields of vision in different directions will correspond, so that any movements of the fingers made by the observer and seen by him above, below, or to either side, should also be seen by the patient. In this way we may rapidly determine if there is any restriction, by simple comparison with a normal standard. One precaution only is necessary in the case, more especially when there is a possibility of slight defects only existing: the examination should be made in a shaded room, with an illumination only just sufficient to cause no restriction in the extent of one's own field.

Various different forms of perimeter are in use. Those who have frequently occasion to make examinations of this nature, naturally prefer one which enables them to effect the examination as rapidly as possible; and for this purpose use is made of a self-registering perimeter, by means of which a chart of the field is pricked off as the examination is being made. A cheap form of perimeter can be made by ruling concentric circles on a black board, the radii of which are determined by multiplying the distance of the eye from the centre of the board by the tangent of 10° , 20° , 30° , 40° , and 50° , a chin-rest being fixed, with a support for the lower margin of the orbit, at a suitable distance from it. To measure the field at a further angular distance from the centre, it is necessary to have a semicircular arm of steel or wood with the degrees marked up to 90° , and capable of revolving round the centre of fixation in a plane parallel with that of the board. In all perimeters there is some arrangement, generally a chin-rest, by which the head is brought into such a position that the eye to be tested occupies the centre of a spherical space, and fixes some object at a distance from it equal to the radius of the spherical surface bounding that space; while the extent of peripheral vision, in any direction and for any particular small object, is given by the angular distance to which that object may be moved away from the point of fixation on the spherical surface. It is obvious that rays from all points on this surface cannot possibly enter the eye—practically indeed, only those from some portion of the half of the surface or hemisphere cut off by a plane

passing through the eye at right angles to the line of fixation. In practice it is found more convenient to use, instead of a complete hollow hemisphere, a quadrant or semicircular arm, which, by rotation round the line of fixation, generates the hemispherical surface, and at any point along which the test object may be brought. This arm is graduated, so that the angular distance of the test object in any position along it can at once be read off, and there is usually a graduated circle as well, which at the same time gives the meridional position of the arm with respect to the eye. The distance of fixation is most conveniently taken at about one foot. On the charts, a series of radiating lines represent the meridional position of the arm, and a system of concentric circles the graduation of the arm itself.

The normal extent of the field is subject to variation at the upper, and slightly also at the inner, parts, owing to individual peculiarities in size and shape of the eyebrows and nose. The physiological limits may be taken to be as follows: upwards, 45° ; upwards and outwards, 50° to 55° ; outwards, 90° (often slightly more); outwards and downwards, 80° to 85° ; downwards, 70° ; downwards and inwards, 60° (variable on account of the nose); inwards, 60° ; inwards and upwards, 55° . The extent of the field upwards, and upwards and outwards, is found to be 5° to 15° greater, when the point of fixation is situated 20° or 30° from the centre of the perimeter in the opposite direction, so that we should not always be right in assuming a contraction in this direction, unless no increased measurement resulted from testing with a lower point of fixation.

The determination of the limits for different colours is a matter of much greater difficulty and uncertainty, as the results are influenced by the hue and shade of the colour used, by the size of the coloured objects, and by the quality and intensity of the light under which the examination is conducted. A precaution, that will be found useful in practice, is to have the test objects differently coloured on either side. In this way we are provided with a check on the accuracy of the patient's statements. The most convenient colour to use is some hue of red, as it is for the reds and greens that pathological defects in the colour-sense almost invariably first manifest themselves. If the test colour chosen be examined carefully at the inner side of the field of vision, it will generally be found to change colour. Before becoming absolutely colourless, it will become yellowish,

brownish, or bluish, according to the hue and shade selected, and it is this tint which may with advantage be used for colouring the opposite side of the test object. When the red-green perception is entirely abolished, the limits may be taken for blue or yellow, the vision for which is longer in disappearing. It is, of course, necessary to exclude the possibility of the more usual form of congenital colour-blindness existing, which we should have reason to suspect if the peripheral boundaries for yellow and blue were not restricted.

But the determination of the limits of the field for quantitative and qualitative stimuli does not exhaust the examination of indirect vision; it is important to ascertain whether or not there is any breach in the continuity of the field. Such interruptions or scotomata are usually divided into positive and negative, according as they give rise or not to a consciousness of the interruption. In the one case there is more or less perception of darkness, in the other an entire absence of any visual impression.

The conditions, in which some alteration or restriction of the field of vision occurs, are optic neuritis and atrophy, the functional forms of amblyopia, retinitis, more especially retinitis pigmentosa, embolism of the central artery and thrombosis of the central vein of the retina, opaque nerve-fibres, glaucoma, detached retina, intra-ocular tumours and foreign bodies, choroiditis and coloboma.

Detached retina.—This defect in the field of vision may occur at any part, and has most frequently a more or less indefinite, ill-defined, and irregular boundary. When caused by a tumour, the defect is usually much more sharply defined than in idiopathic detachment. The freshly detached retina generally retains its functions to some extent, so that it is always advisable to make the examination in subdued light, and, of course, under as nearly as possible identical conditions each time. The boundaries for peripheral colour-vision are narrower than the line separating the detached from the undetached portion of the retina.

Retinitis pigmentosa.—The peculiar features are marked concentric limitation with good central vision. The extreme periphery of the retina does not appear to be subject, in the same degree, to the degeneration which constitutes this disease, and we consequently find that, whilst the function of the greater part of the retina is lost, a zone or belt, or it may be only a small temporal portion, retains a part of its light. The state of peripheral vision is

very markedly dependent on the intensity of light, a fact which is well known in connection with the most prominent symptom of this disease, viz. night-blindness.

Embolism.—A loss of half the field or a sector-shaped defect in it, *limited to one eye*, however, occurs in embolism of one of the principal branches of the central artery of the retina. The defect is generally in the upper or lower half of the field. In embolism of the main artery, a small peripheral portion of the temporal side of the field retains, often, more or less completely its function. See RETINA.

Glaucoma.—In this disease Von Graefe showed that the condition of the field afforded an indication of primary diagnostic importance. The limitation which takes place is usually most marked to the nasal side; frequently, indeed, the field inwards and downwards is destroyed to close up to the point of fixation, when the rest remains as yet but slightly constricted and the vision of the centre tolerably good. If the disease has been acute, the operation of iridectomy is generally followed by widening (sometimes very considerable) of the field. The boundaries of the eccentric colour vision are restricted only to the same relative extent as for black and white. See GLAUCOMA.

Hemianopia.—In uncomplicated cases, there are symmetrical defects in both eyes. When to the same side the hemianopia is homonymous. This is by far the most common form, and may be to the right or left, and partial or complete, that is occupying the whole half of both fields, or only sector-shaped, or even insular, portions thereof. The extent to which the function is destroyed in the defective portions of the field varies also greatly, from complete blindness to hemianopia for colours alone. When the defects are to the temporal side in both fields, or to the nasal side in both fields, the hemianopia is heteronymous.

Optic atrophy.—In progressive atrophy there is invariably a limitation of the field. The limitation often takes place all round (concentric limitation), but in other cases the field in one direction is more restricted than in the rest. The restriction is relatively greater for colours. See OPTIC NERVE.

Scotomata occur either in connection with lesions of the retinal elements or independently of gross anatomical alterations, generally owing to some functional intracranial or cerebral disorder. The first may be of traumatic, inflammatory, or vaso-motor origin or be due to malformation. The cause is generally evident on ophthalmoscopic examination. In diffuse retinitis an

annular or ring-shaped scotoma may often be found, either complete or interrupted at intervals, without any corresponding ophthalmoscopic changes. Large or small insular scotomata, not implicating the centre or extending to the periphery, for which no objective lesion can be detected, are occasionally met with. These are often due to hemicrania, a persistence of the amblyopia which is generally only transitory. Central negative scotomata are met with in a class of cases which are almost always, though not exclusively, of toxic origin. See AMBLYOPIA. The scotoma, which may be so slight as only to be readily demonstrable for colours, takes the form of a horizontal oval, stretching from the portion of the field corresponding to the position of entrance of the optic nerve to slightly beyond the point of fixation.

The examination of the field often affords the most delicate means of ascertaining the course taken by any disease, especially when of intracranial origin. As to the prognosis attaching to the state of the field, it is good if there be no limitation of the peripheral extent, even although there be a considerable scotoma at the centre, if the limitation takes the form of hemianopia in which the portions affected are sharply separated from those in which the function is retained. If, on the other hand, there be limitation of the field without any apparent cause, the probability of subsequent atrophy and blindness is very great. A good deal of prognostic significance attaches to the time which elapses for the production of a defect in the field. Generally speaking, the limitations, which come on suddenly, are not so liable to end in atrophy as those of slow, gradual invasion. G. A. BERRY.

PERINEAL ABSCESS, a collection of pus usually under the deep perineal fascia, occasionally under the fascia or sheath of a corpus cavernosum.

Causes.—In the great majority of cases, the abscess is the result of irritation and ulceration of the urethra behind a stricture; and may immediately arise from suppuration of a follicle or lacuna, due to abscess forming around an ulcer, through which perforation has taken place, and urine in small quantity penetrated into the cellular tissue about the urethra. Sometimes, perineal abscess results from a catheter having lacerated the urethra in its passage; more especially if stricture also exist, when the urine pressed into the wound, excites greater irritation in the wounded part. Inflammation of Cowper's glands, an oc-

casional consequence of gonorrhœa, may excite abscess. Lastly, prostatic abscesses point sometimes in the perineum.

It will be seen that abscesses, arising from the above causes, may be divided into those which are connected with the urethra and those which are not; the former set are the more grave, as they contain decomposed urine, and when the abscess has reached the surface they leave urinary fistulæ.

Beginning in causes of irritation behind the triangular ligament, the matter forms deeply, and is directed forwards along the urethra towards the scrotum, or even further into the sheath of the penis before it reaches the surface. Most commonly, if left to itself, it points near the mesial line just behind the scrotum. Occasionally, the abscess empties itself into the urethra, and such a course, though liable to renewed accumulation and repetition of the evacuation into the urethra, is less serious for the patient.

The *symptoms* of perineal abscess are generally as follow:—A patient, the subject of stricture or of chronic inflammation of the deeper portion of the urethra, feels pain and weight in the perineum, with difficulty of micturition. The stream is smaller than usual, and more force is needed to propel it, the immediate cause of this having been an excess of some kind in wine, sexual indulgence, riding, rowing, tennis, &c. Soon, to the sense of weight in the perineum are added throbbing and symptoms of more or less acute pyrexia, restlessness, thirst, and raised temperature. The perineum may be slightly swollen, tender on pressure; in front of the anus, near the bulbous portion of the urethra, a firm, somewhat egg-shaped, deeply-placed swelling may be felt. Fluctuation is only detected when the abscess has burrowed forwards and by the side of the urethra to the integuments.

The *terminations* of this abscess are various. The matter penetrates in different directions, usually in two or more simultaneously.

In these wanderings it may reach the surface at the perineum or through the scrotum, or by evacuation into the urethra or into the rectum, thus producing fistulæ; which, imperfectly emptied, are continually spreading in fresh directions, so as to tunnel the perineum and scrotum in many *culs-de-sac*. During these alternate accumulations of matter and partial evacuations, the patient is much harassed by pain and fever; and when putrefaction occurs, through mixture of the pus and urine, septic infection, indicated by repeated rigors, great rise and

fall of temperature (ranging in the twenty-four hours from 99°·5 or 100° F. to 103° or 104° F.), is the forerunner of death.

The *diagnosis* of a perineal abscess is formed upon the history of preceding urethral disease or injury, on the presence of difficulty and pain in passing urine, and on the detection of a hard, tender, deeply-seated swelling in the perineum.

The *treatment* is, in the first place, to incise through the mesial line and one inch in front of the anus until the collection of pus is reached; evacuation of the abscess being secured, the treatment of the cause of the abscess, such as stricture, must be undertaken when the constitutional disturbance has subsided. But no loss of time in expecting the abscess to point or open itself on the surface should be allowed. The patient's sufferings are thereby only prolonged and his condition made more critical.

BERKELEY HILL.

PERINEAL BAND.—This is a contrivance, formerly much used in combination with Liston's long splint, to maintain extension in fractures of the femur, or in combination with weight-extension in the treatment of hip-joint disease; in the latter case the band is applied to the perineum on the sound side, and tied to the head of the bed. It consists of a soft but firm band, with a tape attached to each end. The middle of the band is applied to the perineum accurately over the tuber ischii, and the ends are carried, one in front of the groin and the other behind the buttock, to the top of the long splint, where they are tied when sufficient extension has been given to the limb.

The perineal band is objectionable on account of its liability to get soiled, its tendency to excoriate the skin, and the difficulty of keeping it continuously over the tuber ischii. Fortunately, however, we are now able to dispense with it altogether, as a far more efficient counter-extending force can be obtained from the weight of the patient's body, when the foot of the bed is raised; the extension being applied by means of a weight attached to the limb.

BILTON POLLARD.

PERINEAL FISTULA. See URINARY FISTULA.

PERINEAL HERNIA.—The protrusion takes place between the bladder and rectum in the male, and between the vagina and rectum in the female. The tumour is more often to one side of the middle line than directly in that line. The sac either

passes through, or becomes covered by, the levator ani. The contents are usually small intestine, but the bladder has been found in the rupture. The hernia occurs in adults only, and is more frequent in females. It is usually quite readily reduced. The hernia has been inflamed, and has also been strangulated. In the latter condition reduction by taxis has been successful. In no case, apparently, has herniotomy been performed.

FREDERICK TREVES.

PERINEPHRITIC ABSCESS is a common condition, often associated with one or other form of renal disease; indeed, it is a question whether it ever arises independently of the latter. The renal diseases most likely to produce the condition are simple calculous pyelitis, pyonephrosis, or tubercular disease of the kidney. In other words, all the graver forms of suppuration in the organ may give rise to abscess around it by extending outwards until the cortex and capsule are perforated; once the soft, loose, perinephral tissues become inflamed, the process extends more or less rapidly. This suppuration is usually early limited by a plastic deposit at the borderland between the sound and inflamed tissue, so that the abscess is soon distinctly bounded. If this limitation take place close to the kidney, it is often a matter of great difficulty to determine whether the pus lies outside or inside the latter. Fortunately, nowadays, this is not a matter of great importance when the question of treatment alone has to be considered.

In discussing the *symptoms*, it is only necessary to point out the few details in which perinephral abscess differs from pyonephrosis. In the first place, the matter seems to lie nearer to the surface in the loin, as indicated by bulging and fluctuation. With pyonephrosis, the enlargement takes place steadily downwards and inwards towards the umbilicus, and the tumour is sharply defined in this region, while perinephritic abscesses tend to spread backwards and outwards, and are not as distinctly defined to the touch. Urinary symptoms are more frequently absent in extrarenal suppuration than in pyonephrosis; in the former there is very likely to be some amount of inflammation of the psoas muscle, causing flexion of the thigh and pain down the front of the limb. Beyond these the subjective and objective symptoms are identical with those of simple PYONEPHROSIS.

The *treatment* is very simple in uncomplicated cases. It consists in free an-

tiseptic drainage at the point of election behind, as in NEPHROTOMY.

The *prognosis* is good in most cases. After the abscess has been drained thoroughly it soon heals, if it has been opened early, and nothing remains but a little stiffness of the psoas, which soon passes off. But if such a case is allowed to run on untreated, the pus may spread widely across the spine, leading to caries of the latter, or down into the pelvis or front of the thigh, causing much mischief; or it may burst into the cavity of the pleura or peritoneum, or into the intestines. The importance, then, of early diagnosis and free drainage cannot be too much insisted on.

ARTHUR E. BARKER.

PERINEUM, Rupture of the—is a not very uncommon accident occurring during parturition, as the result of too sudden distension of the maternal orifice by the passage of the child's head. The extent of damage inflicted may vary considerably in different cases, the following four degrees of the injury being usually described:—1. Superficial laceration of the fourchette and adjacent portion of the anterior border of the perineum. 2. Rupture of the perineum, not involving the sphincter ani. 3. Rupture extending through the sphincter. 4. Rupture through the sphincter, and involving the recto-vaginal septum. Of these four varieties, the two first constitute what is known as *incomplete* rupture; while the third and fourth illustrate the *complete* form of the injury.

Causation.—*Superficial* lacerations are by no means rare—as an accident liable to occur, to some extent, in the great majority of first labours. The more serious injury of *rupture* of the perineum, incomplete or complete, usually results from one or all of the four following causes complicating delivery:—1. Extreme disproportion between the head of the child and the maternal orifice. 2. Undue rigidity of parts (especially in elderly primiparae). 3. Incautious use of instruments. 4. Prolonged pressure from the child's head, inducing sloughing of the tissues, in tedious and difficult labours.

Symptoms.—*Superficial* lacerations do not, as a rule, give rise to such inconvenience as to render subsequent surgical interference necessary. The *second* variety of *incomplete* rupture, on the other hand, is not unusually followed, in time, by troublesome results consequent upon the loss of support to the vaginal wall, inducing a tendency to prolapse. In the *complete* forms of rupture, the patient's condition is further

aggravated by the resulting loss of proper control over the lower bowel, leading to more or less incontinence of faeces. On inspection in such cases, it will be found that the skin surface of the perineum is replaced by a triangular-shaped projection of cicatrised mucous membrane, of which the base blends with the margin of the patulous anal aperture.

Operative treatment may be either immediate or remote in relation to the occurrence of the injury. Whenever possible, the following plan should be adopted as shortly as may be after the completion of delivery.

Immediate Operation.—The patient lying on her side in the usual obstetric position, the nates should be brought close to the edge of the bed, in order that the extent of the rupture may be fully ascertained, for which purpose a good light is essential. The vagina having been temporarily plugged with a sponge, secured by a string in order to facilitate its subsequent removal, the raw surface of the wound is to be thoroughly cleansed with an antiseptic solution. Two or three sutures are next inserted by means of a curved needle, passed at a sufficient depth to ensure firm consolidation of the ruptured tissues. The wound is then carefully dried with a clean sponge, and the surfaces are brought well into apposition by traction on the sutures, which are finally tied in succession from behind forwards. After removal of the sponge, the vagina should be gently syringed out with a warm antiseptic solution, and this must be repeated every four or six hours, according to the amount of lochial discharge. The urine must be drawn off by catheter three or four times daily. The bowels are to be kept quiet by means of opium until the fourth or fifth day, when four ounces of warm olive oil may be thrown into the rectum, and be followed, in a few hours' time, by an enema of plain water. The sutures can be removed as soon as the bowels have acted.

The *remote operation* for the repair of a ruptured perineum is one of a plastic nature, having for its object the coaptation and subsequent primary union of the freshly denuded surfaces of the fissured part. The difficulties of the procedure required will vary according to the extent of the original rupture, whether incomplete or complete, and will also somewhat depend upon the existence, or not, of any serious prolapse of the vaginal wall. A successful result must further be influenced, not only by the amount of attention paid to

the observance of several important details of the operation, but also very materially by the state of the patient's health at the time of its performance. For this reason it should, as a rule, be postponed until the child has been weaned and the health of the mother is fully restored; all sources of local irritation, such as chronic vaginal discharges, hæmorrhoidal conditions, &c., being attended to before anything is attempted.

The operation, usually, is best undertaken about a week after the cessation of a menstrual period. The patient's bowels having been thoroughly relieved by an effectual purgative on the previous day, the rectum should be further cleared by an enema shortly before she is placed upon the table. After induction of anæsthesia, the nates are brought close to the edge of the table and drawn forcibly apart by the hand of an assistant on either side, who at the same time, maintains the patient's knees in the usual lithotomy position. Before commencing, the operator should well syringe out the vagina with a solution of iodine in water, and insert a sponge. Any hairs are then shaved off the labia, and the parts are carefully cleansed.

The following description of the steps of the operation will suffice for either degree of rupture, no rectal sutures, of course, being required when the sphincter remains intact:—

1. A vertical incision is made on each labium along the line of junction of the skin and mucous membrane, extending from a point corresponding to the termination of the nymphæ down to nearly the level of the anal aperture, where the lateral incisions are next united by a horizontal one, carried across the septum at the junction of the vaginal mucous membrane with that of the rectum.

2. On each side, a triangular flap of mucous membrane is dissected off from without inwards, so as to leave in the middle line a V-shaped portion of mucous membrane, which is next freed, from below upwards, as far as to the level of the upper extremity of the previously denuded lateral surfaces. The apex of this central or vaginal flap should now be held up, by means of forceps, until after the insertion and tying of the deep sutures. In denuding the surfaces, whether with the scalpel or scissors, great care is required to completely remove all trace of mucous membrane. Any bleeding, which is chiefly venous, may, if troublesome, be arrested by the temporary use of pressure-forceps.

3. The rectal sutures are next to be inserted, the number required depending upon the amount of injury sustained by the recto-vaginal septum. The best material for this purpose is fine silkworm-gut, rendered pliable by previous immersion in water. Commencing at the central point of the everted anal margin, the operator passes the needle *from* the rectal aspect to the denuded vaginal surface, and thence directly back again through the mucous membrane of the bowel, of which only the extreme edge should be included, with a view to preventing its inversion. Each stitch should be at once firmly tied, and its ends then cut short before the next one is inserted; the only exception to this rule being in regard to the lowermost one, which it is well to leave untied until after the rest of the operation has been concluded.

4. The introduction of the deep sutures is effected as follows:—A sharp curved needle, set in a handle, is entered on the left side opposite the lower external angle of the denuded surface, at about a quarter of an inch distance from the skin-margin, whence it is directed through the remains of the recto-vaginal septum across the bowel, to finally emerge on the right side at a point corresponding with that of its entry on the left. The eye is now threaded with stout silkworm-gut, which is thus passed through as the needle is withdrawn. If possible, the needle should be kept embedded in the tissues throughout its course, the bowel meanwhile being protected from injury by the operator's finger in the rectum acting as a guide. The number of deep sutures required will vary from three to five, of which the second and third ones are to be passed in the same manner as the first, at successive intervals of half an inch. In the introduction of the two highest sutures, the needle, after traversing the inner aspect of the labium, transfixes the triangular flap of the vaginal mucous membrane (above described) before passing onwards through the right labium, to emerge at a point corresponding with that of its entry on the left side.

In cases complicated by extensive prolapse of the posterior vaginal wall, a wedge-shaped portion may, with advantage, be excised from the centre of the vaginal flap, the edges being afterwards adapted by a series of fine sutures knotted on the vaginal surface, with their ends left long in order to facilitate removal.

5. The vaginal sponge is now removed; the passage is syringed out, and the surface of the wound cleansed by means of a

ream of iced water. The patient's knees are brought together again, and the deep sutures are tied firmly in the order of their section, beginning with the lowest one, care being taken to avoid inversion of the inner edges. Finally, the lowest rectal suture is secured.

The bladder having been emptied by a catheter, a folded napkin is applied to the perineum and retained by a T-bandage. The patient's knees are then fastened together, and she is placed in bed on her side.

A modification of the usual operation, advocated by Mr. Lawson Tait, is based upon the principle of removing no tissue whatever; and, further, of avoiding transsection of the skin-edges in the introduction of the deep sutures.

The procedure consists in splitting the main body of the recto-vaginal septum horizontally, by means of curved, sharp-pointed scissors, along the line of cicatricial tissue in front of the opening in the bowel. This incision serves to define the base of a vaginal flap, of which the sides are next freed by cutting vertically upwards upon the inner aspect of either labium. The deep sutures are then passed in the usual manner, excepting that the point of the needle is both entered and brought out upon the raw surface immediately within the line of skin-margin. No 'rectal' sutures are employed in cases of complete rupture involving the sphincter and septum; the passage of one or more deep sutures across the rent, avoiding transfixion of the immediate margins of the opening, will be found sufficient to ensure its closure. Finally, two or three superficial stitches are introduced anteriorly to limit the vaginal orifice.

After-treatment.—The diet should be light and chiefly farinaceous for the first few days. The parts are to be kept dry, but, at the same time, scrupulously clean by daily washing with a stream of antiseptic solution. The catheter must be used as required; or, if desirable, the patient may be allowed to turn over on her face for the purpose of emptying the bladder, after the first forty-eight hours are over. The bowels should be kept confined by repeated small doses of opium during the first three or four days, after which they may be moved by the injection of warm olive oil, followed by a plain water enema.

Daily evacuation should be subsequently secured by the administration of some mild laxative, as compound liquorice powder in a spoonful doses each night. Mr. Tait

prefers to keep the bowels open from the commencement by the daily use of a small enema. As a rule, the deep sutures can be taken out on the eighth or ninth day, any vaginal sutures being removed at the same time. The rectal stitches may be left undisturbed, provided that their ends have been cut short as directed.

In uncomplicated cases the patient may be allowed to leave her bed at the end of a fortnight. W. A. MEREDITH.

PERIOSTITIS.—Periostitis may be acute or chronic, and of the acute forms there are two very distinct varieties.

SIMPLE ACUTE PERIOSTITIS is very frequently the result of an injury, such as a blow. Syphilis also gives rise to periosteal nodes, which are in some cases quite acute. It may be seen, too, after acute articular rheumatism, typhoid fever, measles, and scarlet fever. In fact, a simple acute periostitis may arise from any cause which reduces a patient below his natural condition of health.

Pathology.—The periosteum becomes vascular, swollen, and in this condition is very readily separated from the bone beneath. This simple form of inflammation generally ends in resolution, and the parts involved return to their normal condition. But it may terminate in suppuration; and, when this is the case, a simple abscess is formed, which has less tendency to burrow far before making its way through the fibrous layer of the periosteum than in the case of the diffuse form of periostitis. Generally, the abscess heals up without any subsequent necrosis, but occasionally the exposed portion of the compact tissue dies, and is removed by exfoliation.

Symptoms.—An acutely tender swelling forms over one of the more superficial bones, such as the tibia. It is found, on examination, to be fixed and connected with the bone, and to be so tender as to admit of very little handling. There is no general enlargement of the bone itself, and the tumour, although connected with the bone, feels as if it were quite upon its surface. The other signs of inflammation, such as heat and redness, are also present, and the pain, which is generally worse at night, may be very troublesome if the part be in a dependent position. Should suppuration take place, the opening formed by nature or the surgeon's art will lead directly down to the bone, when examined by a probe. The temperature will probably be raised several degrees, especially during the first few days, and will be most marked at night.

Treatment.—Leeches, hot fomentations, and a brisk purge will give most relief, and may possibly arrest the progress of the disease. The part should be raised on a pillow, and strict rest enjoined. If syphilis be the cause, notwithstanding the acute symptoms (for as a rule in syphilis the periostitis is subacute or chronic), iodide of potassium alone will obtain, at any rate, temporary relief, and may be looked upon in the early stage as almost a specific. See *Chronic Periostitis*. But in acute periostitis, not dependent on syphilis, iodide of potassium is scarcely so efficacious as in the more chronic forms of this disease. An incision should be made as soon as fluctuation is detected, and may even be made, with considerable benefit, before this event in cases in which the symptoms continue unrelieved. It should be made through the periosteum on to the bone, and antiseptic precautions should, under such circumstances, be adopted to lessen the chances of necrosis.

The constitutional treatment should not be neglected, especially where the disease has followed upon typhoid fever or any other exhausting illness. In such cases the patient will require tonics and a generous diet, but whilst the temperature is raised, fluid nourishment and an effervescing saline draught will probably be more suitable.

ACUTE DIFFUSE PERIOSTITIS OR ACUTE NECROSIS is a much more dangerous disease than the one just considered, and requires the highest surgical knowledge and skill to bring the patient successfully through his illness.

Causes.—It is commonly seen in young and growing boys at or about the age of puberty, the patient being generally rather feeble and ill-nourished. It is very rarely, if ever, seen in those that have reached adult age. Some slight injury appears, sometimes, to be the immediate exciting cause. But this is oftentimes so slight as to have been scarcely noticed, and may even be entirely forgotten. This is all that is definitely known as to the causation of this very curious and interesting affection. It is only fair, however, to say that there are, at the present time, good reasons for believing that the peculiar characters of the disease owe their origin to an infective organism or specific virus, planted no doubt on a suitable soil, but introduced from without. It is beyond the purpose of this article to discuss the interesting points for and against this view of the disease, and the reader must refer to the recent inves-

tigations which have been carried out on animals.

Pathology.—The parts most frequently affected are the tibia and fibula, but any long bone may be the seat of this disease. The flat bones, on the other hand, are very rarely attacked. The inflammation very rapidly terminates in suppuration, and the pus thus formed diffuses itself between the periosteum and the bone over a wide and extensive area. If the inflammation starts in the diaphysis, this stripping of the periosteum stops generally at the epiphysal line. But if it should extend to this line, or start in its neighbourhood, the inflammation may extend into the growing tissue between the shaft and the epiphysis, and then, when the process involves the periosteum from one epiphysis to the other, the whole diaphysis may lie loose in a large abscess-cavity. It is stated that it frequently begins at the epiphysal line, and simultaneously extends down the medullary canal on the inside, and between the periosteum and the bone on the outside. In either case, total necrosis of the whole shaft may be the consequence of this disease. French pathologists assert that total necrosis does not occur without this simultaneous osteomyelitis. The joints, as a rule, escape if the inflammation has begun in the diaphysis, but occasionally the epiphysis itself is involved in conjunction with, or without the shaft, in which case the affected joint may fill with pus, and bring in its train all the dire consequences of suppurative arthritis. Irrespectively of this possibility, pyæmia is especially prone to occur in acute diffuse periostitis. When the periosteum has been stripped from the bone over a considerable area, and incisions are not quickly made, the pus with difficulty makes its way through the fibrous layer of the periosteum; and finally, if still unrelieved, diffuses itself among the muscles, forming oftentimes an enormous abscess before it reaches the surface. There is in such a case no rarefaction of bone as in otitis, but the bone simply dies *en masse*. When this has taken place, and the pus has been evacuated, the periosteum begins to form new bone, and a large ensheathing case is eventually produced, with cloacæ for the escape of pus. The further history of this condition is described under **Necrosis**.

The *symptoms* may ensue immediately after an accident or some slight injury, as has been stated under causation, or there may be an interval of a few days before the onset of acute symptoms. But in either

use this history of an injury, trivial though it may be, is so generally given that it cannot be regarded as a mere coincidence.

Shivering or even a rigor, with a temperature of 102° to 104° Fahr., generally shivers in the attack. Headache, loss of appetite, vomiting, and even diarrhoea may also be present. The local symptoms may at a time be in abeyance, and the patient is thought to be suffering from some acute specific disease, especially as the case will probably be that of a child or youth. In two or three days, the local symptoms manifest themselves by pain and a diffused dematous swelling over one of the long bones, generally the femur, tibia, or humerus.

The *diagnosis* may at the time present some little difficulty—i.e. before the presence of pus can be detected by fluctuation. The question generally arises between such diseases as cellulitis, acute rheumatism, and acute diffuse periostitis. In cellulitis, there has generally been some injury to the teguments by a wound, and the inflammation, starting very soon after the injury, is rapidly spread beyond the next joint; while, in acute diffuse periostitis, the swelling has come on more slowly and been confined to the soft parts covering one bone, and has not passed beyond the neighbouring articulations. In acute rheumatism, on the other hand, the inflammation will be confined to the soft parts near the joint, and on inquiry some other joint will probably be found tender on examination, or to have been so during the illness. Should there still be any doubt as to the presence of deep-seated pus, an exploratory puncture with a narrow-bladed knife can do no harm; and it is a matter of such vital importance to make the necessary incisions as early as possible, this exploratory operation should never be neglected in doubtful cases—to anticipate rather than wait for the formation of pus being the object of every surgeon.

If this is not done, fluctuation becomes distinct in a few days, and on introducing the finger through the openings which are then made, the shaft will be found denuded to a variable extent, according to the severity of the case and the length of time that has elapsed since the pus began to burrow, before making its way through the periosteum. On moving the limb it is possible, at this stage, that indistinct crepitus may be felt between the shaft and the epiphysis. This will not be surprising after what has been said, in a preceding paragraph, on the pathology of the disease.

During all this time the temperature has been high, and the other symptoms of

the febrile condition have continued unchecked, but, as soon as the pus has been evacuated, the temperature generally begins to fall and the patient improves. The temperature may again rise with a fresh collection of pus, indicating possibly the want of a counter-opening or a new area of necrosis. But before this has time to take place, or even in spite of the evacuation of pus, symptoms of pyæmia may supervene, or pneumonia, pleurisy, or pericarditis may bring the case to a fatal termination. If an epiphysis of one of the larger joints, such as the knee, has been primarily involved, and suppurative arthritis has ensued, the dangers of such a calamity have been still further increased. Should the patient avoid all these possible causes of shipwreck, he still has a long and exhausting illness before him, if the entire shaft has become necrosed. The profuse suppuration, in such a case, induces emaciation and exhaustion of the gravest kind, but, where only a portion of the shaft of a long bone has been denuded of its periosteum and has consequently died, the symptoms are proportionately less severe. The steps by which the dead bone is eventually removed are considered under NECROSIS.

There are other less common varieties of this complaint than the one above described. A subacute form is occasionally seen, which is much less dangerous; and a multiple form sometimes occurs, in which several bones are simultaneously attacked. The latter is often rather more of the nature of osteomyelitis, and is especially prone to lead, very early, to a fatal result from septicæmia.

Treatment.—Early and free incisions are here imperatively needed, and can alone save the patient from necrosis of the whole shaft. The finger or probe should be passed into the incisions, to see if more dependent openings can be made than the ones first selected. At the same time—and this is the advantage that the finger has over the probe—the opportunity should be seized to estimate the amount of bone that is already stripped of its periosteum. From time to time free incisions may also be required during the subsequent treatment of the case. Absolute rest upon a good splint is oftentimes a great advantage, and is really necessary in those cases in which the epiphysis or joint is involved. Whether the strictly antiseptic method of Lister should be adopted, in such a case as this, is a matter of choice rather than necessity. Putrefaction and decomposition of the discharges should undoubtedly be prevented. But in

the Listerian treatment of acute diffuse periostitis the dressings have to be frequently changed, or they will quickly putrefy, for sources of putrefaction are already present in the pus before it is evacuated. Personally, the writer prefers, in this particular disease, a more open method of treatment, with frequent injections of an antiseptic solution. The question of amputation of the limb has sometimes to be seriously considered, in cases in which the neighbouring joint has suppurated; and the operation may also occasionally be necessary in feeble patients, who do not rally after the incisions have been freely made, but who seem gradually to get weaker and weaker, and in whom the discharge continues as profuse as before, without any sign of diminution—cases, in fact, in which one thinks there is a poor chance of recovery unless this drain be removed, and that speedily.

If the whole shaft of a long bone has become necrosed and separated from its epiphyses, subperiosteal resection may be employed quite early in the progress of the disease, before new bone has been formed by the periosteum. The patient is thus relieved of a very serious drain upon his constitution; for when this can be successfully accomplished, the amount of pus secreted is very greatly diminished, and the new bone that is formed, after the removal of the old shaft, seems as strong and as sound as when it is left within its periosteal sheath. To facilitate its removal, the dead bone may be divided by a chain saw. Each end can then be easily twisted off from its epiphysis, if it has not already become quite detached. *See SUBPERIOSTEAL RESECTION.*

The removal of sequestra at the ordinary time, when they have become loose and detached within an invaginating sheath of new bone, is discussed under *NECROSIS*. Little need be said about the constitutional treatment of this disease, for it is evident that everything must be done which will assist in supporting the patient through an exhausting and trying illness. Tonics and a stimulating nutritious diet must be given as far as they can be borne. Morphia may also be necessary to allay pain, and soothe the irritable condition into which many of these patients fall.

3. CHRONIC PERIOSTITIS.—Simple uncomplicated chronic periostitis is rare, except in syphilis. It is the custom, however, to call almost all cases of thickening and enlargement of bone periostitis, whereas, undoubtedly, osteitis is generally the primary condition

in these cases, whilst the periosteum is only secondarily involved. Consequently, the reader must look to the article on *OSTITIS* for much that he might possibly expect to find here. Taking, then, the syphilitic forms first, as being by far the most important, we find that syphilitic nodes are due to a more or less chronic inflammatory infiltration of the deep layers of the periosteum. They occur both early and late in the disease. The earliest appear between the second and third month after infection, generally on the superficial bones, and yield very readily to treatment. The later variety do not often appear before the second year, and frequently not till a still more advanced period; but, in exceptionally rapid cases, they may trouble the patient somewhat earlier in the disease than even the second year. They do not yield so readily to treatment, and often lead to a development of new bone on the surface of the old. Occasionally they suppurate, and give rise to a troublesome sinus or ulcer. Dead bone is generally found at the bottom of this sinus, but may take years to separate from the living; such sinuses are therefore very slow in healing. The gumma may affect the periosteum as it does other tissues, and, if unrelieved, softens in the usual way, exposing the bone beneath. The latter is then found to be superficially affected, and often falls into a carious and necrotic condition, leading to those frightful ulcerations of bone which are now rarely seen except in our museum specimens.

There is still another form of chronic periostitis, and that is the osteoplastic variety accompanying osteosclerosis. The periosteum here slowly develops new bone, which may be arranged in layers parallel to the surface or in nodulated masses. When the latter assume a definite size and outline, they are sometimes called osteophytes. The new bone that is laid on parallel to the surface, in chronic osteitis, is at first spongy, with large vessels surrounded by round cells and running at right angles to the surface. Part of this new bone is again absorbed, but in a great measure it undergoes the same sclerotic change that occurs in condensing osteitis, and leaves the shaft so much the larger. It is doubtful whether there are other definite causes besides syphilis for the conditions above described. Localised patches of chronic periosteal thickening are seen both in hereditary syphilis and struma, but they are quite as much osteal as periosteal, like the cases of osteosclerosis above alluded to, except that they are generally rather more limited in extent.

Symptoms.—Pain of a dull aching kind, worse at night and in wet weather, is the principal and most characteristic symptom, the chief complaint which is made being the inability to get to sleep after going to bed. This pain is rarely acute. On examination, a swelling is generally felt on passing the tips of the fingers over the part complained of; this is most likely to be the shin or the superficial parts of one of the long bones, such as the tibia, ulna, or clavicle. The superficial soft tissues are found quite free from inflammation, unless a node has accidentally suppurated or the case be one of gummatous periostitis. Tenderness on pressure will vary greatly in different patients, but it is not often acute, although occasionally the slightest touch seems to cause great pain, even in men who are not otherwise very sensitive. This is, however, more generally seen in the earlier nodes, which have been before mentioned under *Simple Acute Periostitis*.

Treatment.—For the early syphilitic nodes, it is not necessary to discontinue the mercurial treatment that has already been begun. The pain and swelling generally disappear as soon as the patient is fully under the influence of the drug. If this fail, the administration of small doses (gr. v.) of iodide of potassium, for a few days, is almost certain to give immediate relief. But unless mercury is continued, as it is for the other early syphilitic manifestations, over a long period, the nodes are liable to return, whether iodide of potassium be given or not. For the later forms of syphilitic periostitis, including the gummata, even when they are fluctuating, iodide of potassium, in gradually increasing doses from gr. x. to gr. xxx. t.d.s., is generally sufficient to procure a very decided and marked improvement in all the symptoms. Occasionally, the improvement is neither very marked nor very prolonged. Mercury should then be given till the gums are slightly touched. It is not often that this is required, and scarcely ever in the gummatous form of periostitis. But when the disease does not readily yield to iodide of potassium, mercury should most certainly be tried, and most suitably in the form of blue pill gr. v. daily, or, if this be insufficient to make any impression, twice a day. Blisters sometimes give great relief, and should always be employed in conjunction with the above treatment, if there is much pain and tenderness. If, notwithstanding the treatment here prescribed, the symptoms still persist, free division of the periosteum at the most tender spot will some-

times do all that is required and bring the case to a successful termination.

If suppuration takes place, notwithstanding the above treatment by iodide of potassium and mercury, and the skin becomes thin, the abscess should be opened with the fullest antiseptic precautions, so as to avoid, if possible, the occurrence of necrosis.

H. H. CLUTTON.

PERIPROCTITIS.—Inflammation of the tissues surrounding the rectum.—The lower part of the rectum, when at rest, is normally closed by tonic contraction of the circular muscular fibres, by which the mucous membrane is thrown into longitudinal, closely approximated folds. During defæcation the tube is more or less considerably distended. In constipated or flatulent subjects, the distension may be very great and permanent from accumulated fæces or flatus. To admit of this variation in calibre, the bowel is surrounded by lax cellular tissue, which below becomes continuous with the adipose tissue of the ischio-rectal fossæ. This cellular tissue contains a large quantity of adenoid tissue, partly diffused and partly aggregated in nodules resembling the solitary glands of the intestine.

This tissue is not infrequently inflamed, and the inflammation may be acute or chronic. It may occur spontaneously, probably from irritation of the adenoid tissue in phthisical patients, or from direct violence, as from blows or kicks, or even from exposure to cold. It may also be due to perforation of the rectum by ulceration or by foreign bodies, as enema-tubes, rectal bougies, fish-bones, &c.; or it may be secondary to inflammation of adjacent parts, as of the prostate, bladder, vagina, or from necrosis of the sacrum or coccyx. If fæcal matter escape from the bowel into this tissue, the inflammation is very severe and extensive.

In the *acute* stage, the patient complains of a sensation of heat and weight in the perineum, and of pain in defæcation. If the inflamed part be small and at some distance from the surface, there may be no external evidence; but if neglected, the inflammation will rapidly spread, and a hard brawny swelling will be found occupying one or both ischio-rectal fossæ. The chronic form is very insidious, and, if due to inflammation of adjacent parts, may fail to attract attention. If neglected, it may result in considerable denudation of the bowel.

When the patient complains of pain in defæcation, without any external sign of the cause, the rectum should be carefully ex-

plored with the finger; and if any part of the mucous membrane be discovered to be swollen, tender, and hotter than the rest, the left forefinger being retained in the bowel as a guide, a straight knife should be introduced alongside the bowel from the anal portion of the perineum, and pushed steadily onwards to a level with the tip of the guiding finger. If suppuration has already commenced, as is usually the case, the exit afforded for the pus will give relief and probably prevent perforation of the bowel. If there be no pus, the bleeding from the inflamed part will prove serviceable. Any more superficial suppuration must be incised in the usual manner, and the cavity washed out with carbolised water. The pus is usually extremely ill-smelling, even when there is no direct communication with the bowel. The wound may be dressed with iodoform and filled with cotton wool. If a rectal fistula result, it must be treated according to the condition of the part.

In *chronic* cases, any retained pus must be evacuated and the wound dressed in a similar manner. Sinuses must be either laid open or irrigated, according to their extent and direction. The exciting cause must also be treated as the requirements of the case may suggest. The patient must be kept at rest in the horizontal position, and an easy daily action of the bowels ensured by suitable diet and purgatives.

JEREMIAH MCCARTHY.

PERITONITIS, or inflammation of the serous membrane that lines the abdomen and covers the contained viscera, is, like inflammation of other tissues, brought about by various agencies, of which the effect is to lessen the vitality of the parts assailed, and to lead to more or less manifest changes in structure and function.

The *causes* of peritonitis are: (1) Bruises, and the resulting irritation; (2) wounds of the abdominal wall and organs, with infiltration of fæces, urine, or other irritating material; (3) ulceration or gangrene of the intestine, with the like infiltration of injurious material; (4) the distributed infective particles of pyæmic, tubercular, and malignant disease. The varieties of peritonitis are, accordingly—(a) simple, (b) septic, and (c) specific, while in extent it may be 'partial' or 'general,' and in degree 'chronic' or 'acute.'

Anatomical Changes and Mechanism.—In the event of bruise, the peritoneum may be the seat of ecchymosis in varying degrees, punctiform or diffuse, as may be seen on post-mortem examination after early death

associated with fractured pelvis, ruptured viscera, &c. A slight amount of what is virtually simple peritonitis may attend the infliction of a bruise, and is present in wounds of the peritoneum which heal by a perfectly aseptic process. But, under both conditions, the recovery of the patient is so simple and speedy that the evidence of peritonitis is not conspicuous, and, in the event of death from other cause, its anatomical traces may be confined to an inconsiderable adhesion or superficial scar—provided that the parts be kept at rest. Undue intestinal movement, brought about by the use of food improper in such circumstances, may, however, aggravate the simple peritonitis to the exudation of extra lymph and its resulting adventitious adhesions. Permanent traces of previous peritonitis occur in the form of fibrous tissue variously attached to the serous surface, as smooth bluish-white opacities, streaky cicatrices, close adhesions, delicate fibrous shreds, or firm cords and bands. In extent, the above forms of simple peritonitis are 'partial.' In chronic (simple) peritonitis associated with ascites, the surface of the membrane may be slightly injected and thinly coated with granulations, lymph, or both, in the absence of pus, decomposition, and constitutional infection. In extent, chronic peritonitis is 'general.'

In the event of extensive putridity, as on the decomposition of blood or serum after operation, or on the flooding of the serous sac with the juices of the alimentary canal through sudden perforation of intestine, the result is a rapidly fatal septicæmia, chiefly characterised before death by collapse, with sometimes an entire absence of inflammatory phenomena. Petechiæ on the peritoneum and other serous membranes are not uncommonly found after death in septicæmia, and are not to be confounded with those of ecchymosis. Between these extremes are found average cases of 'acute peritonitis,' which may be 'partial' or 'general,' according to the extent to which the serous surfaces are implicated, and in which the inflammation is not infrequently partial at first, and subsequently spreads until more generalised, or until 'universal.'

Acute peritonitis is always septic, and occurs under circumstances of wound, ulceration, gangrene, and pyæmic or other metastatic infection. In perforating wound of the peritoneal cavity, decomposition may arise from without; in wound of the intestine, by issue of fæces from within; in ulceration, by leakage of fæces; in gan-

green, by imbibition through the putrefying issues; and in pyæmic abscess at the surface of the liver, the source of peritoneal irritation is evident. The anatomical changes denoting acute peritonitis are exudation of lymph, pus, or both, and vascular injection, which are as apparent after death as during life. The amount of lymph exuded may be no more than a stippled film, or may be enough to be stripped off with the fingers; while its colour may be yellow, straw, brown, or green. The pus exuded may have any consistence between that of milk and that of clotted cream, with any of the above colours. Either exudation may exist singly, or the two may be combined in any proportion. The vascular injection may vary from the scantiest redness to a crimson or purple velvety fulness on the parietal or visceral surface, like the condition of the eye called 'pannus.'

In the specific peritonitis of tubercle, the exudation is found, as the name implies, in dotted nodules, which vary from the size of hardly visible grains to that of mustard-seeds, green, yellow, white, or opalescent, often on a pink ground of vascular injection, at various distances apart, or forming a continuous granular membrane.

In various forms of malignant disease, the peritoneal membrane is found to be dotted in varying extent and profusion with scattered nodules of tumour-growth, averaging a size between those of mustard-seeds and peas, but in some instances forming considerable masses. Their colour is often simply white; but pink, red, or purple tints may be imparted by a varying blood-supply; while an additional or alternative yellow stain may be present through general jaundice or local bile-staining. The anatomical resemblances between tubercular and malignant infiltration of the peritoneum are sufficiently great to render their distinction in some cases difficult, without regard to other circumstances. To the latter condition the term 'malignant peritonitis' is sometimes applied.

The symptoms of peritonitis are local and constitutional. The local consist of pain, tenderness, and the impairment of visceral muscular functions. The constitutional are alterations in the temperature, pulse, and respiration, and also in the demeanour and facial expression. There is lastly the act of vomiting, a symptom probably indicative of local irritation and of constitutional sympathy combined.

The pain and tenderness in cases of bruise are great at first, and may be aggravated if the parts concerned be not

kept at rest. In cases of perforation of the bowel and flooding of the peritoneum with faecal fluids the pain is great, as if from the pungent irritation of the noxious matters, and ceases only in advanced collapse. In acute peritonitis, more slowly brought about by similarly septic means, the pain and tenderness are conspicuous, the area of the latter being proportioned to the 'partial' or 'general' extent of the affection. In tubercular and malignant infiltration the pain may be, and commonly is, *nil*.

The temperature in peritonitis may be raised or lowered. The painful state of mere bruising may be attended with elevation of temperature, apparently due to the pain; while the onset of the same condition may be ushered in with a lowered temperature and a certain amount of shock. In acute—that is, in septic—peritonitis the temperature is also commonly elevated a few degrees at first, followed in later stages by depression. Local changes may have something to do with this, as in the case of bruising, but the major part of the change, whether elevation or the reverse, is probably due to septic absorption, for exactly similar elevations and depressions of temperature are well known in cases of septic poisoning not arising in the abdomen. The pulse is characterised by greatly increased rapidity and hardness, which in the acute form of peritonitis is almost 'wiry' to the finger.

The respiration in peritonitis is sometimes quickened and shallow, owing to pain and tenderness affecting the respiratory muscular efforts, especially when the peritonitis is diaphragmatic. Part of this may be due to a febrile state and quickened pulse when they exist.

In peritonitis of all kinds, there is a tendency to impairment or irregularity of the intestinal muscular functions. This may be accompanied by flatulent distension, or may follow a state of contraction, both of which conditions may be found in different portions of the same bowel. In consequence of impaired intestinal functions, whether strictly localised or affecting a considerable length of the gut, constipation may result, and is commonly recognised as a frequent attendant symptom. But, also actual obstruction of intestine, sub-acute and even acute, may directly result from acute peritonitis, and its symptoms may be those which alone attract attention.

Vomiting occurs in cases of severe abdominal contusion and concussion, but does not commonly persist. In acute peritonitis vomiting generally occurs, and per-

sists while food or drink is administered, on the early avoidance of which it is mitigated, while it can be totally allayed by the subcutaneous administration of morphia. In tubercular and malignant peritonitis vomiting is not regularly present, and may be totally absent.

The *diagnosis* of acute traumatic peritonitis is based upon the presence of pain, tenderness, abdominal distension, and vomiting, following an injury. In that due to perforation of the intestine or vermiform appendix, with slight or gradual leakage, the same typical symptoms exist; but the suggestive circumstance of the injury is not present, and thus an important diagnostic aid is wanting. In either, the symptoms referring to peritoneal injury may be masked by those due to blood-poisoning, and attempts at diagnosis may fail, or may even reveal only those of intestinal obstruction, until post-mortem inspection clears up the obscurity of past events. Cases of perforation of the appendix, in which the leakage is not intraperitoneal, may result in abscess, iliac or lumbar, with or without subsequent fecal fistula; and may, in cases of still less severity, cause symptoms identical with those of typhlitis and perityphlitis. In cases of bruise the conspicuous local pains, together with the circumstance of injury, render a recognition of peritonitis not difficult, even though the symptoms are not immediately apparent; while in tubercular and malignant peritonitis there are often—in fact, usually—no symptoms by which even a clue can be gained, except in the event of ulceration, when by fecal contact acute peritonitis may be set up, with the symptoms above related. See PERTYPHLITIC ABSCESS.

The *treatment* of peritonitis is simple enough, whatever be its cause. The local symptoms to be combated are pain, tenderness, and the tendency to flatulent distension. The pain and tenderness can be counteracted by opiates and by alcohol; speedy relief being obtained in a state of urgency by morphia subcutaneously given. Any of its salts act well if pure, the hydrochlorate and acetate being quite satisfactory when fresh, but liable to decomposition after long keeping. The sulphate seems to retain its purity longer than any other salt of morphia, and is consequently to be preferred, in doses, for an adult, of from a quarter to half a grain in the first instance. After even frequent repetition, it is hardly likely that more than half a grain will be required, while for a first dose, urgently needed, less than a quarter of a grain can

seldom be relied upon for this purpose. In the absence of urgency, the same drug may be confidently given, and found satisfactory, by the mouth, in doses varying from an eighth to a quarter of a grain, repeated every four, six, eight, twelve, or twenty-four hours. Under the same circumstances laudanum or liquor opii sedativus, in doses of ten to sixty minims, may be equally relied on. A dose of wine or spirit and water, administered by preference hot, may be given occasionally to supplement, or even in mild cases instead of, the opiate. For children, the same medication by the mouth, in doses appropriate to their age, on the scale of a drop of laudanum for each year of life, cautiously increased or repeated if relief be not speedy, will generally suffice.

The diet should at the same time be entirely liquid, and confined to small quantities of beef-tea, soups, or water-arrowroot suitably sweetened and flavoured with alcohol. Meat and fish should be rigorously avoided, except in the preparation of broth, which should be carefully strained; milk should be equally strictly interdicted until the symptoms are checked; and even bread should not be given pending improvement. At first, in fact, and during the existence of severe symptoms of any kind, it is better to avoid nourishment altogether, and to put off its administration until temporary ease is obtained, and even until craving hunger on the patient's part demands it. Warm tea, barley water, toast water, and the like, may at most times, however, be judiciously given to relieve thirst. When the pain is gone, and has shown no tendency to return, bread or toast may be broken into the tea and broth, and this kind of diet should be continued until a stool passes. In even a mild case, properly managed, much time is saved by omitting the food at first; while, in cases of more severity, a rigid attention to diet is essential, and will often result in a spontaneous easy stool in the first or second week after a previous obstinate constipation. But during recovery, moderate flatulence, without special pain or tenderness, may exist with constipation and scybala, especially if the diet have not been scrupulously attended to, and will then yield to a well-timed simple enema of hot water. It should be distinctly understood, however, that such interference is not justifiable during the existence of symptoms indicating any degree or stage of the original affection, and is only permissible during the period of actual convalescence.

The application of fomentations, poultices, or dry heat, to the abdomen is found

to be acceptable in many cases of peritonitis. The alternative abstraction of heat by laying on an ice-bag or a wet cloth (preferably in a single layer) is productive of exquisite comfort in other cases.

The above treatment may be uniformly adopted in all forms of peritonitis, and is no less successful than essential in severe remediable cases. The mildest instances are always the better for it, though no doubt susceptible sometimes of spontaneous recovery, while septic cases generally prove fatal in spite of all treatment. Even in fatal cases, however, some of the symptoms are combated by the treatment, and the sufferings of the patient minimised.

RUSHTON PARKER.

PERITYPHLITIC ABSCESS.—A localised collection of pus formed in connection with the cæcum or its appendix, situated either within or without the peritoneal cavity. By some authors the term is limited to abscesses commencing in the loose areolar tissue behind the cæcum. Taking the broader significance of the term, we must separate perityphlitic abscesses into intra- and extra-peritoneal. These forms differ from each other sufficiently to justify a separate description, though clinically it is often difficult, and sometimes impossible, to distinguish one from the other.

EXTRA-PERITONEAL PERITYPHLITIC ABSCESS.—*Anatomy.*—The loose tissue behind the cæcum is a part of the general subperitoneal areolar tissue. It is continuous above with the fat about the kidney, and internally with the loose tissue surrounding the iliac vessels and with the pelvic cellular tissue. A collection of pus, forming immediately behind the cæcum, can readily extend upwards to the kidney, inwards to the brim of the pelvis, and forward to the groin above Poupart's ligament. It is prevented from reaching the thigh by the attachment of the fascia iliaca and fascia transversalis to Poupart's ligament. Should it extend inwards to the pelvic cellular tissue, it may escape from the pelvis with the gluteal or sciatic artery through the great sciatic notch, and thus appear in the buttock, but it is shut off from the perineum by the recto-vesical fascia. It is possible for the pus to make its way to the surface along the spermatic cord or through the femoral ring, but such a course is extremely rare. In the majority of cases it comes forward, and appears above the outer part of Poupart's ligament. When the abscess is very acute it may perforate the iliac fascia, and thus come in direct contact with the ilio-psoas muscle, and it

may then extend upwards towards the spine, and downwards to the thigh, taking the course of an ordinary psoas abscess. This is, however, a rare occurrence. Abscesses arising in connection with the kidney, or in the pelvic cellular tissue, can easily extend in the subperitoneal fat to the neighbourhood of the cæcum, and may thus appear to have commenced in that region.

Causes.—An extra-peritoneal perityphlitic abscess most commonly arises as a complication of disease of the cæcum, with or without perforation of the gut. When not a consequence of perforation, it probably commences in the lymphatic glands which lie behind the cæcum. The diseases which give rise to it are—simple typhlitis from faecal accumulation; and ulceration from tubercle, typhoid fever, dysentery, or stricture of the great intestine at some point lower down. Cancer of the cæcum may lead to perforation in its later stages. Perforation of the vermiform appendix near its root may also be a cause of an extra-peritoneal abscess. In some cases, the appendix is placed completely behind the cæcum, and an abscess resulting from any disease of it would then be situated behind the gut. Perforation of the cæcum at any part covered by peritoneum very rarely causes a localised collection of pus, as it is usually speedily fatal from diffuse peritonitis. In some exceptional cases the abscess may arise without any recognisable cause.

Symptoms.—The special symptoms of a perityphlitic abscess are preceded by those of the disease to which it is secondary. It would be out of place here to describe the symptoms of typhoid, dysenteric, or tubercular ulceration of the cæcum, and those of stricture of the great intestine and of cancer of the cæcum are fully treated of under **INTESTINAL OBSTRUCTION**.

The symptoms of simple typhlitis are pain and tenderness in the region of the cæcum, with swelling taking the form of the distended gut. At first the pain is dull and aching, and the tenderness is not usually very acute, but by the second or third day, if the attack does not subside, the symptoms become more severe. It not uncommonly happens that the exacerbation takes place somewhat suddenly, so as almost to suggest that perforation of the gut has taken place, but the absence of collapse and of the signs of diffuse peritonitis is sufficient to show that this is not the case. The sudden increase in the severity of the symptoms is believed to be due to an extension of the inflammation to the peritoneum covering the cæcum. When this has taken place, the tenderness

is such that no accurate examination by manipulation is possible without the administration of an anæsthetic. In order to relieve tension the patient lies with his right thigh flexed. Nausea and vomiting are common symptoms at this stage. The bowels are usually confined throughout the attack, and most commonly the patient has suffered for some time from habitual constipation. It occasionally happens, however, that, even in cases of very considerable fecal accumulation in the cæcum, a channel may exist through the mass, allowing of the passage of a daily motion. The temperature, which is normal at the beginning of the attack, usually becomes slightly elevated during the period of acute tenderness. Under proper treatment by rest, hot fomentations, and small doses of opium, the symptoms gradually subside in about a week from the commencement of the attack; some hardened feces are passed, either naturally or by the help of enemata, and the patient recovers. In most cases he remains liable to similar attacks throughout life.

The extra-peritoneal perityphlitic abscesses must, for the description of their special symptoms, be divided into two classes—those that do not communicate with the gut, and those that do.

In the abscesses not communicating with the gut, the pain and tenderness which have attended the previous typhlitis, instead of subsiding, become more acute, and the swelling becomes more distinctly localised in the outer and lower part of the iliac fossa, in the neighbourhood of the anterior superior spinous process, and the outer end of Poupart's ligament. The temperature rises to 103° Fahr. or more, with evening exacerbations. There may possibly be a rigor, but this is not common. Accurate examination is scarcely possible without an anæsthetic, but, when the muscles are relaxed, a firm elastic swelling fixed in the iliac fossa can easily be recognised. Fluctuation may be difficult to detect, owing to the depth at which the fluid is placed. On observing the movements of the abdominal wall during respiration, it will be noticed that they cease at a point some distance above Poupart's ligament, instead of reaching to the groin as in health. At this stage of the disease, recovery may take place by the abscess discharging itself into the cæcum, but this can only occur if the tissues round the abscess are sufficiently consolidated to prevent fecal extravasation, and if the opening is sufficiently free to drain the cavity. Under

other conditions, the communication with the gut only aggravates the disease and hastens the advance of the abscess. Should the abscess continue to advance without this complication, the swelling increases, redness and œdema appear above the outer end of Poupart's ligament, and fluctuation becomes distinct. In the great majority of cases the abscess remains limited to the iliac fossa, extension upwards towards the kidney, or inwards towards the pelvis, being very rare. Perforation of the iliac fascia and extension downwards to the thigh are also extremely rare.

If the abscess from the beginning communicates with the gut, or if it continues to extend as a consequence of imperfect drainage after opening into the cæcum, the progress of the disease is usually more acute. The temperature is higher, the constitutional disturbance greater, and rigors are not uncommon. In fact, the contents of the cavity now being necessarily very foul, symptoms of septicæmia or pyæmia may appear before the pus reaches the surface. Extensive burrowing, either upwards and inwards, or downwards upon the thigh after perforation of the fasciæ, is also far more common than in the non-perforating abscess. The chief local symptom of communication with the gut is the presence of gurgling or crepitation on manipulation, and tympanitic resonance on percussion over the swelling in the iliac fossa.

Both forms of abscess, if unrelieved by treatment, usually perforate the abdominal muscles near the anterior iliac spine. They then expand over the iliac region beneath the deep layer of the superficial fascia of the abdomen. Thus, an apparently superficial abscess, on being opened, may be found to communicate by a narrow neck with a large cavity in the iliac fossa. Less frequently, the pus burrows between two of the muscles entering into the abdominal wall. Finally, the abscess will burst, discharging extremely offensive pus. If there is no communication with the gut, the offensive odour is merely due to the close contiguity of the fluid with the bowel, and soon disappears. If the gut is perforated, fecal matter is mixed with the discharge, and, as the cavity contracts, a fecal fistula or artificial anus may remain, according to the size of the opening.

Diagnosis.—An extra-peritoneal perityphlitic abscess has to be distinguished from—(a) an ordinary iliac or psoas abscess connected with disease of the bones of the pelvis or the vertebræ; (b) an acute abscess following a strain or other injury of the

psoas or iliacus; (c) a perinephritic abscess extending downwards; (d) an abscess following pelvic cellulitis, extending upwards and outwards into the iliac fossa. The diagnosis is often extremely difficult. If the abscess is chronic, and is accompanied by considerable signs of irritation of the psoas, and if it extends down to the thigh beneath Poupart's ligament, it is probably connected with the bones. An acute abscess, early passing under Poupart's ligament, would also have probably commenced beneath the iliac fascia. A perinephritic abscess, by the time it reaches the iliac fossa, would probably cause distinct fulness in the lumbar region, and would, in the great majority of cases, be accompanied by pus in the urine. Pelvic cellulitis occurs almost exclusively in women, and is recognised by a vaginal examination. Still, as a true perityphlitic abscess may extend upwards to the kidney and inwards to the pelvis, and may, moreover, perforate the fasciæ and extend to the thigh, it is evident that the diagnosis must be, in many cases, very difficult. Even the presence of gas in the cavity is not proof that the abscess is truly perityphlitic, as both perinephritic abscesses and those arising in pelvic cellulitis have been known to perforate the intestine. The diagnosis must, in many cases, depend very much upon the previous history, and even here it is not always easy to distinguish between attacks of typhlitis and of renal colic.

Pathology.—The post-mortem appearances present nothing peculiar. The interior of the abscess is frequently foul and the walls sloughing.

Treatment.—The prevention of suppuration in typhlitis belongs rather to the physician than the surgeon. It is sufficient to state here that rest, hot fomentations, restricted diet, and moderate doses of opium form the essential features of the treatment. Purgatives and enemata are calculated to increase the danger of suppuration. When there is reason to believe that suppuration has taken place, if the symptoms are not very acute, the same treatment may be continued for a short time in the hope that the abscess may discharge itself by the bowel. As soon as the swelling becomes superficial, and the hope of spontaneous cure is past, an opening should be made. This should not be delayed after it is evident that the abscess is advancing towards the surface. Should any doubt exist as to the presence of pus, the swelling must be explored with the aspirator, but in such cases aspiration is seldom sufficient to cure the disease. If

the symptoms are not very acute, it may, however, be tried once or even twice before making an opening. If the pus is very offensive, or if it contains faecal matter, it is better to open at once. The opening should be made by an incision close to the anterior spine, if possible. The skin and fascia and the external oblique only need be divided with the knife, the deeper parts being opened up with a pair of polypus-forceps. A large drainage-tube should then be inserted, and some form of antiseptic dressing applied. Should fæces escape with the pus, little can be done, beyond drainage and cleanliness, to avoid the formation of an artificial anus or faecal fistula. Should these form, their treatment is most unsatisfactory. The opening in the bowel being at the posterior part of the cæcum, it is impossible to reach it, and the gut is too firmly fixed by adhesions for it to be possible to perform the operation of enterectomy, as has been done for artificial anus in other situations.

INTRA-PERITONEAL PERITYPHLITIC ABSCESS is, almost invariably, the result of perforation of the vermiform appendix. Should any disease lead to perforation of the cæcum in the part covered by peritoneum, rapid death from general peritonitis almost always results.

Perforation of the vermiform appendix is most commonly caused by the presence of a concretion or foreign body within it. According to Dr. Fenwick, who has collected and analysed 129 published cases, amongst those in which the nature of the obstructing body is recorded, 28 were concretions, 14 hardened fæces, and 5 foreign bodies. Amongst the cases in which no concretion was found, tubercular ulceration seems to have been the most common cause of perforation, and a few occurred during or after typhoid fever. Concretions are most common in males under twenty years of age.

The effects produced by perforation of the vermiform appendix will vary with the anatomical relations of the part and the situation of the ulceration. According to Mr. F. Treves, the appendix commonly lies behind the end of the ileum and its mesentery, and is directed upwards and towards the left. In the only other common position it ascends vertically behind the cæcum. It may, however, be so placed that its free end lies at the brim of the pelvis. If perforation takes place near the attached end, or if the whole tube lies behind the cæcum, the abscess would be in the same situation as that resulting from disease of the cæcum,

and would be indistinguishable from it. When the appendix occupies its more common situation, and when the perforation occurs in the free part, it is followed either by general peritonitis, usually fatal under a week, or by the formation of a collection of pus enclosed in a cavity, formed by the surrounding coils of intestine firmly united to each other by adhesions. According to Dr. S. Fenwick, in 95 cases of which accurate details could be obtained, 38 presented localised collections of pus.

Symptoms.—Premonitory symptoms may be entirely wanting, but occasionally there is a history of obscure pains in the right iliac fossa, or of periodic attacks indistinguishable from ordinary typhlitis.

When the abscess forms behind the cæcum, the symptoms are those already described of extra-peritoneal perityphlitic abscess.

In the cases in which the perforation is followed by diffuse peritonitis, there is usually a sudden invasion, often during some violent exertion. The pain commences in the right iliac fossa, but soon extends to the whole abdomen. There is constipation, distension of the abdomen, and absence of evident movement of the intestine. The abdomen is tender, but most markedly in the right iliac fossa, where some fulness may be felt. The symptoms are much less severe than those of perforation of the stomach or other parts of the intestine, as the extension of the inflammation is less rapid, owing to the absence of the abundant extravasation of the intestinal contents. For the same reason collapse is not marked. Vomiting, often of dark-coloured matter, is a marked symptom, as in all other forms of peritonitis.

The symptoms of perforation with localised peritonitis are much more obscure. The invasion is usually somewhat sudden. There are localised pain and tenderness in the right iliac fossa. The pain resembles colic in character. There is usually constipation, but it may alternate with diarrhoea. Vomiting is commonly present. After a day or two, an irregular, diffused elastic swelling may be felt in the right iliac region. It is most commonly situated rather higher up and more internal than the swelling formed by an extra-peritoneal abscess. At this time rigors are not uncommon, and the temperature may reach 108° to 104° F. If unrelieved by treatment the swelling increases, and most commonly after a time, perhaps extending into the third week, the symptoms of general peritonitis supervene and the patient dies. At

no time, as a rule, can fluctuation be felt in the swelling, owing to its deep situation and the difficulty of fixing it. Should the abscess lie nearer the pelvis than usual, there may be irritability of the bladder, and sometimes a firm mass can be felt from the rectum, composed of the adherent coils of intestine round the abscess. Cases have been recorded in which recovery took place by the abscess discharging itself into the bowel, but such a fortunate issue is so rare that it cannot be taken into consideration. Almost every case, if not relieved by operation, will die.

Pathology.—At the post-mortem examination, general peritonitis with purulent fluid in the peritoneal cavity is the most marked feature. The amount of fluid varies considerably, but is often not very great. The intestines are intensely injected, and adherent to each other by soft adhesions. In the localised form, a cavity is found containing pus, the walls being formed of the surrounding intestines glued together by firm adhesions.

Diagnosis.—In the diffuse form, the diagnosis from other forms of perforative peritonitis can only be made by the comparative absence of collapse, by the commencement of the pain in the right iliac fossa, by the tenderness in that region, and by the somewhat gradual extension of the inflammation to the peritoneum generally. The localised form most closely resembles simple typhlitis, and sometimes can hardly be distinguished with certainty. As a rule, the swelling is more diffused and more acutely tender at an early period than in simple typhlitis, and the constitutional symptoms are much more marked.

Treatment.—Until recently, patients suffering from perforation of the vermiform appendix were practically left to die under the soothing influence of opium, when their end was not hastened by purgatives, enemata, and other violent measures. There is, however, no doubt that whenever perforation takes place, the only chance of life lies in opening the abdomen early, and freely draining the cavity. This is applicable to those cases in which there is general peritonitis, and still more so to those in which the mischief is localised, whenever a diagnosis can be made.

The incision should, as a rule, be made above the outer part of Poupart's ligament, and should be about three inches in length. The muscles should be carefully divided and the peritoneum freely opened. The vermiform appendix should then be sought for, and, if it be found and is evidently

diseased, it may be ligatured with catgut and cut away. If there is diffused peritonitis, with purulent fluid amongst the coils of intestine, an attempt may be made to clean the cavity by means of sponges, squeezed as dry as possible after being soaked in some antiseptic solution, such as carbolic acid (1 in 40), corrosive sublimate (1 in 500), or tincture of iodine (f3ij. to Oj.). If the pus is distinctly localised in a cavity, it is better not to attempt to clean it out, for fear of breaking down the surrounding adhesions. After the operation a large drainage-tube should be inserted, and the wound closed as far as possible by sutures. The operation should be performed with antiseptic precautions, and some antiseptic dressing be applied afterwards.

It may be necessary, in some cases, to modify the incision. Should the swelling be situated nearer the middle line, the abdomen might be opened at the outer border of the rectus, but care must then be taken not to wound the epigastric artery. The middle line can seldom be a suitable situation for the incision, as, being so far removed from the seat of the disease, the drainage would not be efficient.

This operation has been performed in a considerable number of cases with very encouraging results. MARCUS BECK.

PES GIGAS (*Synon.* Macropodia).—This affection is that form of congenital hypertrophy which is limited to part of one extremity, usually the foot, though occasionally the tissues of the leg as well are affected.

Two varieties are met with—(a) *symmetrical* or *true*, in which the whole foot or limb is colossal, all its parts being developed to an equally gigantic degree; (β) *unsymmetrical* or *false*, in which only portions of the foot are altered, either by large fatty excrescences, or by one or two gigantic toes, or by both conditions together. The tissues chiefly affected are the integumentary and the bony. Then there is great increase of the fatty subcutaneous tissue, which often takes the shape of pads or lumps; coexisting with these, capillary nævi, often of large extent, may be met with; other angiomas are more rare. The arteries do not seem liable to change, the veins are often varicose and thickened, the lymphatic vessels dilated, whilst the glands are unaffected.

Where colossal toes are present, the phalanges and metatarsal bones are enlarged and greatly elongated, but all parts of the enlarged bones are usually in proportion. With regard to the muscles and tendons going to the enlarged toes, the

former are not usually over-developed, the latter are much elongated. In some cases, a confused matting together of the muscles in the sole has been observed. The ligaments are much thickened, and secondary articular distortion is not infrequent. The affection never interferes with birth. The causes are quite unknown.

Treatment.—Pressure is always to be tried as early as possible and persisted in, by means of strapping, elastic stockings, or Martin's bandage. If pressure be made judiciously and perseveringly, steady diminution in the size of the foot or limb may confidently be expected. But it must be remembered that pressure, however used, must not be applied too tightly in young subjects, especially where a nævoid condition of the skin is present, otherwise ulceration, hæmorrhage, and a low form of erysipelas are only too probable.

Ligature of the main artery has been suggested, but, judging from the varying results which have followed upon its adoption for elephantiasis, this step is not to be recommended, save in cases where persevering pressure has failed, or where the congenital hypertrophy is accompanied by unusual pulsation in, or undoubted increase in the size of, the arteries, or by large angiomas not yielding to other means.

In cases of symmetrical or true hypertrophy, amputation will not be required if pressure is made use of early and persevered with. Before proceeding so far, the surgeon will do well to bear in mind that 'an unnaturally heavy and cumbrous limb is after all as good as a wooden leg' (Holmes).

In cases of unsymmetrical hypertrophy, amputation of any large toes should be resorted to early. If this enlargement coexist with localised overgrowths of fat, so as to render the foot cumbrous and the wearing of boots difficult, removal of a portion or all of the foot should be resorted to.

W. H. A. JACOBSON.

PHAGEDÆNA.—This term is applied to a disease which occasionally occurs in hospitals in this country, and also in private houses, and which by some is designated as 'hospital gangrene.' It differs essentially, however, from this disease, both in the slighter ravages which it produces, and also in the fact that it may originate quite independently of any hospital contamination or influence.

Causes.—There can be no doubt that in many cases this disease is distinctly syphilitic in its origin; but there can be as little doubt that it may occur quite independently

of this cause. During the year 1863 a severe epidemic of this disease occurred in St. George's Hospital, no less a number than ninety-two cases occurring. Many of those attacked were quite young children, or individuals in whom there could not arise the slightest suspicion of syphilis, and it seems impossible to believe that the whole of these ninety-two patients could have been the subjects of that malady. It is, no doubt, possible that this disease may be generated by dirt and overcrowding, and therefore owe its origin, in some cases, to defect in hospital management, and want of proper hygienic precautions; but, nevertheless, the facts elicited in the above-mentioned outbreak prove that it cannot always be attributed to this cause. For, of the ninety-two patients suffering during this outbreak, in only nineteen did the disease break out in the wards, the remaining seventy-three occurring out of the hospital, some of them never having been near the building until they were brought suffering from the phagedæna.

Symptoms.—The disease presents itself in two forms: in the one there is the formation of black sloughs; in the other the wound spreads by a sort of ulcerative process, and without the formation of distinct sloughs. In the former case, the wound becomes dry and loses its healthy appearance, the surrounding parts become swollen and tense, and of a bright red colour, but speedily become darker, the wound being covered with a black slough. This extends, the inflamed tissue falling into a condition of gangrene. After a time, however, the progress is arrested, a line of demarcation forms, and the slough slowly separates in the form of greyish-black viscid masses.

In the other variety, there is no formation of a slough, but a rapid liquefying or melting away of the parts. The surface of the sore assumes a greyish appearance, and becomes covered with a semi-gelatinous fluid. The edges gradually melt away into this material, and there is no swelling, cedema, or redness of surrounding tissues.

Treatment.—In considering the treatment of this affection, a distinction must be made between those cases which owe their origin to a syphilitic cause and those which do not. In the former nothing but mercury appears to have any influence in checking the progress of the disease, and the best plan of administering it is by means of local calomel fumigation. The fumes of calomel (from 15 to 20 grs.), applied locally to the sore once or twice a day, rarely

fail to arrest the sloughing in a surprisingly short space of time. The non-syphilitic form requires a different plan of treatment. Here, the free administration of opium, and a liberal diet, with a judicious supply of stimulants, the sore being at the same time covered with a charcoal poultice, rarely fail to arrest the disease. Some surgeons recommend the free application of fuming nitric acid to the part, but the treatment appears to be unnecessarily severe, causes very considerable pain, and does not—at all events, in every instance—succeed in arresting the sloughing. The local irrigation of the wound with a solution of carbolic acid or sulphurous acid has succeeded, in the writer's hands, in checking the gangrene when other means have failed. Mr. Hutchinson has recommended, in these cases, the treatment by a warm bath. The patient is placed in a bath at a temperature of about 96° to 98° F., and is kept there for eight consecutive hours. This is repeated daily until the gangrene is arrested. While in the bath, care is taken to maintain the water at the same temperature. Those who have tried this plan speak warmly of its success.

T. PICKERING PICK.

PHANTOM TUMOURS. See ABDOMINAL TUMOURS, Diagnosis of.

PHARYNGEAL STENOSIS.—*Definition.*—A constriction or narrowing of some portion of the pharynx, due to cicatricial contractions following ulceration.

Cause.—Generally syphilitic, occasionally strumous, and, more rarely, simple ulceration.

Pathology.—The constriction may be met with in three situations—first, between the naso- and mid-pharynx; secondly, between the mouth and pharynx; thirdly, in the lower pharynx about the level of the hyoid bone. Stenosis occurring at the junction of the pharynx with the œsophagus will be found described under *Strictures*. See *ŒSOPHAGUS, Injuries and Diseases of the*.

I. In the first situation, the stenosis is produced by the adhesion of the soft palate to the posterior wall of the pharynx, into contact with which it has been drawn by the contraction of cicatrices following ulceration about the posterior pillars of the fauces. In this way the upper part of the pharynx may be completely cut off from the rest of that cavity, and from the mouth; but usually a small aperture is left between them about the situation of the uvula, which is itself generally destroyed by the ulceration.

II. The constriction between the mouth and the pharynx is due to the soft palate being drawn downwards towards the base of the tongue, through contractions and adhesions following ulceration about the anterior pillars of the fauces. Here the stenosis is never complete, although the aperture left for the passage of food, &c., between the soft palate and base of the tongue may be exceedingly small.

III. Stenosis in the lower pharynx is the result of an extensive ulceration of the pharyngeal walls about the level of the hyoid bone, the subsequent contraction of the cicatrices drawing in the tissues concentrically, so that the pharynx assumes in this situation an hour-glass shape. The stricture is situated above the opening of the larynx, and the aperture left has to serve for the passage of both food and air. Complete stenosis, therefore, is incompatible with life; but the writer has seen the pharynx so constricted at this spot that it would barely allow the passage of a crow-quill.

Symptoms.—When the stenosis is between the naso- and mid-pharynx, beyond some alteration in the voice but little inconvenience is usually experienced. When between the mouth and pharynx, in addition to some alteration of the voice, there will be more or less difficulty in swallowing according to the extent of the contraction. In stenosis of the lower pharynx, there is increasing difficulty in swallowing, with attacks of cough and dyspnoea on exertion. Soft food only can be swallowed, and this but slowly and in small quantities at a time, while paroxysms of suffocative dyspnoea occur if a larger morsel than usual is attempted to be taken.

Diagnosis.—In the first and second situations the stenosis is evident on inspection; and in the third it is readily made out by the laryngoscope.

Treatment.—Stenosis between the upper and mid-pharynx seems to be beyond the reach of treatment. Were the aperture enlarged it would rapidly re-contract, and, could it be kept open, would only cause the patient greater inconvenience by allowing the regurgitation of food, &c., through the nose. When swallowing is seriously impeded by a constriction between the mouth and pharynx, the tissues may be divided in an upward direction either by the knife or galvano-cautery, and re-contraction prevented by the daily passage of a bougie. But, if little inconvenience is felt, the stricture is better let

alone. Stenosis of the lower pharynx, when at all extreme, calls imperatively for treatment, as life is endangered from the liability of a portion of food to block up the narrowed passage. With the aid of the laryngoscope, the cicatricial tissue should be divided in the middle line in a backward direction, by a guarded knife or the galvano-cautery. The writer has found a Ricord's urethrotome admirable for the purpose. Further dilatation may subsequently be obtained, and re-contraction prevented by the daily passage of bougies of increasing sizes. Tracheotomy as a preliminary had better be done, since the manipulation sets up very severe paroxysms of cough and dyspnoea, and, during division of the tissues, death has followed from blood escaping into the trachea.

W. J. WALSHAM.

PHARYNGOTOMY. See ŒSOPHAGOTOMY.

PHARYNX, Diseases of the.—PHARYNGITIS, or inflammation of the pharynx, although it sometimes occurs alone, is generally associated with more or less inflammation of the palate and fauces, and has a tendency to spread to the larynx and nasal passages. The inflammation is commonly of the catarrhal variety (*acute and chronic catarrhal pharyngitis*); but it may fall chiefly upon the glands of the pharynx (*granular or follicular pharyngitis*), or more rarely may spread deeply and end in diffuse suppuration (*phlegmonous or suppurative pharyngitis*). Sometimes it is attended with deficient secretion and atrophy of the mucous membrane (*pharyngitis sicca*), and occasionally it assumes an erysipelatous character (*erysipelatous pharyngitis*), and is then generally associated with erysipelas of the face.

(a) *Acute Catarrhal Pharyngitis*, or common sore-throat, is generally the result of exposure to cold. It is attended with more or less fever and malaise, and usually terminates spontaneously in a few days. The familiar symptoms of soreness or pain in swallowing, hoarseness, and perhaps slight deafness, and the local redness and swelling vary according to the intensity and extent of the inflammation. Confinement to the house, and an aperient followed by a simple saline mixture and an astringent gargle, are all that is generally required in the way of treatment.

(b) *Chronic Catarrhal Pharyngitis*, or 'relaxed sore-throat,' may follow on repeated attacks of the acute, or be induced by gastric disturbance, the abuse of alcohol,

tobacco, &c. It is characterised by a sense of dryness of the parts, especially in the morning, by a constant desire to moisten or clear the throat, and, if the uvula is elongated, by a tickling cough. The mucous membrane is slightly red and swollen, and frequently covered with tenacious mucus, and the uvula is often relaxed and elongated.

Treatment.—The exciting causes must be carefully avoided, the bowels regulated, and the health improved by tonics. Locally, an astringent gargle or lozenges may first be tried; but, if the affection be obstinate or of long standing, local remedies, to be effectual, must be applied either by the brush or in the form of sprays. Amongst the remedies that may be thus used with advantage are chloride of zinc (gr. x.—xx. to fʒj.) or tannin dissolved in ether, applied with the brush; and sprays of chloride of ammonium, bicarbonate of sodium, alum, &c. (gr. v.—xxx. to fʒj.). When the uvula is much elongated, its extremity should be removed.

(c) *Granular or Follicular Pharyngitis*, also known as ‘clergyman’s sore-throat,’ is a chronic inflammation of the mucous follicles of the pharynx, and is not infrequently associated with a similar condition of the mucous follicles of the naso-pharynx, posterior nares, entrance of the larynx, and upper part of the oesophagus.

Causes.—A debilitated, and especially a strumous constitution, appears to predispose to the affection; whilst long-continued over-exertion of the voice, exposure to cold, and the breathing of air charged with irritating particles or fumes are amongst the chief exciting causes. Hence the affection, though met with in others, is most common in those engaged in public speaking, as clergymen, auctioneers, &c., and in photographers, employed in chemical works, &c.

Pathology.—The constant contact of cold or vitiated air renders the mucous membrane dry, and stimulates the follicles to over-secretion. The extra work thus thrown upon the follicles leads to catarrhal proliferation of their epithelium, blocking of their orifices, retention of secretion, and general hypertrophy of the tissues of which they are composed. In some cases, the hypertrophy prevails and the secretion rapidly diminishes; in others, the secretion continues excessive, and the follicles become distended and exude a viscid mucus or even a caseous material, whilst very little hypertrophy ensues. Hence, the disease has been divided into the hypertrophic and exudative varieties. In the hypertrophic form it would appear, from the observations

of Stoerk, that isolated proliferations of the general epithelial covering of the pharynx also occur.

Symptoms.—A sense of dryness in the throat, hoarseness, loss of power over the voice, a continual hawking and desire to swallow for the purpose of clearing the throat, and a tickling, dry, harsh, or painful cough, are commonly complained of in the early stages of the disease. Later on, these symptoms become more pronounced, and complete loss of the voice, pain and difficulty in swallowing, impairment of hearing, and even permanent deafness and loss of the sense of smell may supervene, as the disease spreads to the surrounding parts. The pharynx presents somewhat different appearances, according as the disease assumes the hypertrophic or exudative form. In the former, the hypertrophied follicles and epithelial elevations give the posterior wall of the pharynx a characteristic granular appearance. The granules are at first scattered and isolated, of a lenticular shape, and of a deeper colour than the rest of the mucous membrane; but subsequently they coalesce, forming flattened masses or ridges. In the exudative form, the follicles appear distended with secretion, and a viscid mucus can often be seen adhering to them. The mucous membrane between the granules may be either hypertrophied or atrophied, and is generally traversed by large and tortuous veins.

Treatment.—The general health must be improved by attention to the secretions, by tonics, and change of air, all exertion of the voice being forbidden, and every known source of irritation avoided. Locally, the granulations must be severally destroyed by the galvano-cautery wire, the actual cautery, or the solid nitrate of silver fused on the end of a silver probe. Two or three of the granulations only should be destroyed at a sitting, which, as a rule, should be made not oftener than twice or three times a week. Between the application of these remedies, the parts may be painted with solutions of chloride of zinc, or sprayed with weak astringent lotions of alum, tannin, and the like. To allay the irritation sometimes caused by the destruction of the follicles, lozenges containing opium, chloride of ammonium, or bromide of potassium, or inhalations of steam may be prescribed.

(d) *Phlegmonous or Suppurative Pharyngitis* may occur spontaneously, or follow an injury of the pharynx. The inflammation spreads deeply and widely; the submucous tissue, and even the constrictor

muscles, become infiltrated with inflammatory products; and suppuration frequently ensues. The pus may track down the course of the pharynx and oesophagus, or make its way forward into the tissues of the neck, compressing the upper air-passages and obstructing the entrance of the larynx.

The *symptoms*, at first those of ordinary sore-throat, rapidly become alarming. Swallowing becomes difficult or impossible, respiration laboured, the pulse rapid, and the tongue furred and brown. The pharynx is intensely red and swollen, the neck often puffy and cedematous, and death usually follows, in three or four days, from sudden spasm of the glottis.

Treatment.—The strength must be supported by fluid nourishment and stimulants. Brand's extract, strong beef-tea, and the brandy-and-egg mixture, should be given in frequently repeated doses, or administered by the rectum if the patient is unable to swallow. The atmosphere should be kept moist and steam occasionally inhaled, and sulphate of quinine (gr. v.) taken every three or four hours. Preparations for instant tracheotomy should be made, and the operation performed as soon as it becomes evident that life is in danger from spasm of the glottis. Should suppuration occur in any accessible situation, an incision, to allow free exit to the pus, should be made.

(e) *Pharyngitis Sicca*, or atrophic pharyngitis, appears to be the result of repeated attacks of catarrh. The mucous membrane is thin, dry, and glazed, the normal secretion is completely absent, and the veins are varicose. The symptoms are those of soreness and dryness of the throat, in speaking and swallowing. The disease admits only of palliative treatment. For this purpose cubebs, given both locally and internally, inhalations of steam, tincture of benzoin, and the like, will be found useful.

ULCERATION.—Ulceration, when it attacks the pharynx, is seldom limited to that cavity, but, like inflammation, more often affects at the same time the soft palate, fauces, and tonsils; whilst not infrequently the base of the tongue, the epiglottis, and sometimes the larynx and nasal cavities also become involved in the process. Ulceration of the pharynx may occur in the course of syphilis, struma, and tuberculosis, on the breaking down of epitheliomatous and other growths, on the bursting of herpetic vesicles, and in connection with ulceration of the tonsils in the affections known as simple and malignant ulcerative sore-throat.

(a) *Syphilitic Ulceration* may be divided into the superficial and deep. Superficial ulceration may occur both in the earlier and later stages of syphilis. In the earlier stages it is generally due to the erosion of syphilitic mucous patches, then so common about the fauces, palate, and tonsils. The ulcers are generally symmetrically arranged, quite superficial, sharply defined, covered with a grey mucopurulent discharge, and surrounded by a slight areola of redness. In the later stages, superficial ulceration often assumes a serpiginous form, and extends widely over the pillars of the fauces and palate. Deep ulceration is nearly always due to the breaking down of gummata, and only occurs in the later stages of syphilis. The ulcers are circumscribed, their edges sharp-cut, slightly overhanging, and surrounded with an areola of a characteristic coppery red colour, and their base is covered with a yellow purulent discharge, mixed with shreds and *débris* of breaking-down tissue. The ulceration is sometimes limited to the posterior wall of the pharynx, but generally attacks simultaneously the soft palate, tonsils, fauces, and base of the tongue, and frequently the larynx and nasal cavities. It often extends deeply, leading to caries or necrosis of the adjacent bones; while the subsequent cicatrization may lead to various forms of occlusion and stricture of the pharynx. See PHARYNGEAL STENOSIS.

Treatment.—For the ulcerations occurring in the earlier stages, small doses of mercury should be given internally, while the throat may be gargled with 'black-wash,' or painted with a solution of nitrate of silver, chromic acid (gr. x. to f 3j.), or boroglyceride. For the later ulcerations, large doses of iodide of potassium (gr. x., xv., or even gr. xxx. three times a day), combined with decoction of cinchona or quinine, should be given internally; whilst the parts should be cleansed with gargles of chlorate of potash, carbolic acid, or chlorinated soda, and then dusted with iodoform, or painted with a strong solution of nitrate of silver.

(b) *Strumous Ulceration*.—Many pathologists do not admit the existence of strumous ulceration in the pharynx, the variety here described as such being regarded by them as the result of congenital syphilis, modified by the strumous constitution of the patient. This form of ulceration is most frequently met with in badly nourished and strumous children, especially of the poorer classes. Generally

beginning in the soft palate, it gradually spreads to the fauces and back of the pharynx, and sometimes to the hard palate and nasal cavities, slowly but persistently destroying the parts and often producing great deformity; more rarely it begins in the posterior wall of the pharynx. The ulceration is generally sharply defined, though the mucous membrane around may be slightly thickened; the edges of the ulcer are raised and everted, not sharp-cut as in syphilis, nor surrounded by the coppery red zone so characteristic of the latter affection. The base is covered by a ropy, greyish, muco-purulent discharge, through which here and there granulations are seen projecting, giving it a mottled, pinkish appearance.

Treatment.—Cod-liver oil, combined with syrup of iodide of iron, or the compound syrup of phosphate of iron in drachm doses, with unstimulating diet and residence at the sea-side, are the constitutional measures attended with the best success. Locally, the parts should be well cleansed with a weak carbolic lotion, and then dusted with iodoform, or cauterised with nitrate of silver fused on the end of a probe. If there is any suspicion of a syphilitic taint, anti-syphilitic remedies should be combined with local treatment.

TUBERCLE.—Deposits of miliary tubercles are occasionally met with in the pharynx, as one of the local manifestations of acute general tuberculosis. In the earlier stages, the tubercles appear as scattered or confluent patches of grey granulations on the sides and posterior wall of the pharynx, often also on the palate and roof of the mouth. They differ from syphilitic mucous patches, for which they have been mistaken, in the absence of the inflammatory zone of redness, and in their more translucent appearance. Later, they break down, leaving small lenticular ulcers with slightly overhanging and hyperæmic edges and a caseous-looking base, while fresh crops of miliary tubercle are deposited around. The symptoms are those of acute pulmonary consumption, with local soreness of the throat, and the patient usually succumbs to the lung-affection in a few months.

HERPES.—An eruption of herpes, similar to that which occurs on the skin, is occasionally met with in the pharynx. The affection appears to be of neurotic origin, and is most prevalent in damp and cold climates. It usually runs an acute course of a week or ten days, and is attended with more or less smarting pain, soreness

of the throat, and fever. The eruption is mostly limited to one side, and is more common on the fauces and soft palate than on the posterior wall of the pharynx, while a similar eruption is often present upon the lips and corners of the mouth at the same time. The vesicles either disappear in a few days, leaving no trace, or they break down into small superficial ulcers, which in some cases become covered with a false membrane. When several such ulcers become confluent, the membrane covering them may be mistaken for that of diphtheria; but the presence of a few scattered ulcers as yet uncovered by membrane, and of similarly shaped, isolated patches of the membrane itself, and the absence of any tendency of the disease to spread, are points which will usually serve to distinguish herpes. An aperient, followed by small doses of quinine and the use of a simple gargle, is all that is generally required by way of treatment.

W. J. WALSHAM.

PHARYNX, Extirpation of the.—This operation has within the last few years been performed in some instances for the removal of growths which, from their situation in the lower pharynx, have been hitherto considered beyond the reach of surgery. The following is the method devised by Langenbeck:—Tracheotomy is first performed, and the trachea plugged with Trendelenburg's tampon-cannula. The head being well drawn back and the face turned to the opposite side, an incision beginning just below the lower jaw, midway between the symphysis and the angle, is carried over the greater cornu of the hyoid bone in the direction of the sternohyoid to just above the tracheal wound. The integuments, platysma, and omohyoid are divided, and the posterior belly of the digastric and stylo-hyoid muscles detached from the hyoid bone. The superior thyroid, lingual, and facial arteries and veins, and the superior laryngeal nerve and its external branch are next divided. The pharynx is then opened, and the larynx drawn firmly to the opposite side, and rotated so that its posterior surface is well exposed. The front and side walls of the pharynx are now detached from their connections, and the posterior wall is divided transversely on a level with the lower border of the soft palate, and separated from the vertebral column. The pharynx, with the growth, is then finally removed by severing it from the œsophagus. A tube should be placed in the œsophagus

or the purpose of feeding the patient, and the tampon-cannula retained in the trachea for some days, to further guard the air-passages from the entrance of food, saliva, and the secretions from the wound.

W. J. WALSHAM.

PHARYNX, Injuries of the.—These may be classified under—(1) Incised, lacerated, punctured, and gunshot wounds, inflicted either from within, through the mouth, or from without, through the neck; (2) burns and scalds, due to the sudden passage of flame, as in a gas explosion, swallowing boiling water or inhaling steam; and (3) charring or other chemical lesion of the mucous membrane from drinking strong acids or caustic alkalies.

(1) *Wounds* are not uncommonly inflicted from within, by the patient falling whilst holding a sharp-pointed body, as a pipe-stem or stick, in the mouth; by the forcible extraction of a sharp-angled body, as a false-tooth plate which has been impacted in the lower pharynx, by the incautious use of probangs, &c. Wounds from without are usually inflicted with a suicidal or homicidal intent. In these the pharynx is generally wounded in front, between the hyoid bone and thyroid cartilage (*see* THROAT, Injuries of the). Wounds of the pharynx, particularly the punctured variety, may be attended by fatal hæmorrhage, consequent upon a large vessel being penetrated or subsequently opened by ulceration of its walls. They are not infrequently followed by acute cellulitis, due to the escape of food into the tissues of the neck, or to the instrument with which the wound was inflicted being broken off short and remaining as a foreign body. Circumscribed collections of pus may also result from like causes. *See* RETRO-PHARYNGEAL ABSCESS.

(2) *Scalds* of the pharynx are most frequent in young children, from inhaling steam or drinking hot water from the spout of a tea-kettle. They should always be regarded as grave, from their liability to be followed by cedematous laryngitis.

(3) *Lesions* of the mucous membrane, caused by swallowing corrosive liquids, are generally of secondary import to the graver injuries which are usually simultaneously inflicted upon the stomach, larynx, or œsophagus. *See* ACIDS, ALKALIES, Swallowing

the arrest of hæmorrhage. Any bleeding vessel that can be seized should at once be tied. In punctured wounds about the fauces, inflicted from within the mouth, the bleeding vessel may be invisible, or if seen it may be impossible to ligature it. In such a case attempts should be made to twist it, or if this fails the forceps may be left on. If the source of the hæmorrhage cannot be discovered, and is not very severe, the patient should be given ice to suck, an ice-bag may be placed on the side of the neck, or solid perchloride of iron applied to the wound, or pressure made upon it by means of a stick wrapped round with lint. These means failing, or the hæmorrhage threatening life, the common carotid, as a last resource, must be tied. Where a foreign body, as a portion of a pipe-stem, is found in the wound, it should not be removed till the common carotid has been compressed and preparations have been made to tie it if required, as a fatal gush of hæmorrhage has been known to follow its extraction. When the wound is so situated that food is liable to escape into the tissues of the neck, the patient should be fed by the rectum for the first few days. Should suppuration occur, an early outlet for the pus must be made. *See* RETRO-PHARYNGEAL ABSCESS.

In burns and scalds of the pharynx, and in injuries from swallowing corrosive liquids, &c., the patient should be carefully watched for signs of cedematous laryngitis, and everything should be in readiness for tracheotomy. Milk diet should be prescribed, or nutrient enemata if the patient is unable to swallow. *See* SCALD OF THE GLOTTIS.

FOREIGN BODIES IN THE PHARYNX.—Fish bones, pieces of meat, false-tooth plates, and coins are the foreign bodies that have most frequently been found in the pharynx. The situation at which they are most liable to become impacted is opposite the cricoid cartilage, where the pharynx narrows to join the œsophagus; but they may also become lodged between the tongue and epiglottis, and, in the case of fish-bones or pins, in the tonsils or between the pillars of the fauces. Bodies like the latter, moreover, may be impacted lengthways across any part of the cavity.

Symptoms.—These necessarily vary according to the nature and situation of the foreign body and the length of time that it has been impacted. A small sharp-pointed body, as a fish-bone, may cause a pricking sensation in the parts and some distress or pain in deglutition, symptoms which, owing to the scratching of the mucous membrane,

Treatment.—For the treatment of suicidal and gunshot wounds of the pharynx, *see* THROAT, Injuries of the, and GUNSHOT WOUNDS of the Neck. In wounds of the pharynx, attention should first be given to

may continue after the bone has been dissolved or swallowed. Large bodies, as a false-tooth plate, may cause great pain on swallowing, or render the act altogether impossible, or may produce severe paroxysms of cough and dyspnoea from reflex spasm of the glottis, or from direct pressure upon the larynx; while a large mass of food may cause fatal suffocation by blocking up the pharyngeal opening of the larynx. Though cases are on record where foreign bodies have remained in the pharynx for a long time without causing much irritation, their continued presence has usually led to ulceration, perforation and fatal hæmorrhage, peri-oesophageal abscess, or œdematous laryngitis.

Diagnosis.—A careful inspection, aided by the laryngoscope and finger, will usually detect a foreign body if lodged about the fauces, base of the tongue, or region of the cricoid cartilage. When beyond the reach of the finger, its detection may be difficult. Nothing may be felt externally, and it may be only after a long and patient examination by pharyngeal forceps, œsophageal bougies, coin-catchers, &c., with the patient under chloroform, that its presence and situation is at last discovered.

Treatment.—If a portion of meat or other substance is obstructing respiration, the finger should at once be plunged into the throat and attempts made to dislodge it. If these fail and suffocation is imminent, instant laryngotomy should be performed. A fish-bone, pin, or false-tooth plate, when within reach of the finger, may often be hooked out with the nail, or, if seen, be readily extracted with the dressing-forceps. When the foreign body is too low down to be felt by the finger, its extraction, especially in the case of a false-tooth plate, may tax the ingenuity of the surgeon. The patient had better be put under chloroform, and attempts made to grasp the plate with pharyngeal forceps having blades opening in different directions. By passing these closed, and using them as a sound, the plate may be struck and a fair estimate formed of its position. Considerable force may have to be used in its removal, as the hooks, by which the plate is attached to the teeth, often become embedded in the tissues. When the forceps fail, attempts should be made to snare the foreign body with one of the various forms of coin-catchers, or to sweep it out in front of the bristles of the expanding horsehair extractor. Whilst passing these instruments beyond the foreign body, care must be taken not to force it lower down the passage. Sometimes an emetic,

or, where this could not be swallowed, one-sixth of a grain of apomorphia injected subcutaneously, has succeeded. This treatment, however, is not unattended with danger, and should only be employed under exceptional circumstances. If attempts at extraction fail, three courses are open: to remove the foreign body by the operation of *ŒSOPHAGOTOMY*; to try and push it down into the stomach; or to allow it to remain, in the hope that it may become loosened by ulceration. The first plan of treatment is, in the writer's opinion, the right one to pursue.

W. J. WALSHAM.

PHARYNX, Tumours of the.—New-growths in the upper part of the pharynx, and at the junction of its lowest part with the œsophagus, are treated of in separate articles. See *NASO-PHARYNGEAL GROWTHS*; *ŒSOPHAGUS, Injuries and Diseases of the*. Nearly all varieties of tumour have been observed in the pharynx; all are rare in this situation, but the fibrous, the fibro-myxomatous, the fatty, the epitheliomatous, and the sarcomatous are perhaps the least so. Pharyngeal growths may be pedunculated or sessile, and may spring from the back or lateral walls of the pharynx, the soft palate, the base of the tongue, and the region of the epiglottis and aryteno-epiglottidean folds. They may have their origin in the mucous membrane or submucous tissue, in the fibrous covering of the vertebræ, or in the bodies of the vertebræ or intervertebral cartilages, and in the glands by the side of the pharynx. When arising behind the pharynx, they are sometimes spoken of as post- or retro-pharyngeal tumours.

Symptoms.—The tumours often attain a considerable size before the surgeon is consulted, the patient's attention being first called to them by difficulty in swallowing, obstructed breathing in certain attitudes, from the growth either pressing upon or partially occluding the opening into the larynx, or, when the growth is high up, by some alteration in speech. When arising behind the posterior wall, they push the mucous membrane before them, and appear as smooth, globular, uniform projections in the cavity of the pharynx. They may be hard and resistant, or soft and fluctuating, and fixed or movable, according to their origin and attachments. A rapidly growing sarcoma or other soft solid tumour may greatly resemble a retro-pharyngeal abscess, and the diagnosis can often only be made by puncture with a grooved needle. See *RETRO-PHARYNGEAL ABSCESS*. A new-growth in the lateral wall may be simulated by an

aneurism of one of the carotids. Care only is required, however, to make the diagnosis.

Treatment.—Small and pedunculated growths may be readily removed either by ligature of the pedicle and excision, or by the cold wire or galvanic *écraseur*. Before deciding upon the removal of sessile and larger growths, a careful investigation of their attachments and connections should be made, both by the finger and laryngoscopic mirror, as these may be such—especially when the growth involves the lateral wall—as to preclude the possibility of its extirpation with a reasonable chance of the patient surviving the operation. The retro-pharyngeal growths, when unattached to the vertebræ and of moderate size, may often be shelled out with ease by the finger, after a vertical incision has been made through the mucous membrane covering them. In attacking a growth of large size, where there is a probability of much hæmorrhage, preliminary tracheotomy should be performed, and the tracheal wound plugged with Trendelenburg's tampon-canula, to prevent the escape of blood into the air-passages. For malignant growths involving the aryteno-epiglottidean folds, the removal of the larynx will probably be necessary. This question is fully discussed under LARYNX, Growths in the. Recently, Langenbeck has extirpated the whole pharynx or malignant growths beyond reach by the mouth.

W. J. WALSHAM.

PHIMOSIS is a malformation of the prepuce which prevents its being retracted behind the glans penis. It is either congenital or acquired. In congenital cases, the prepuce is abnormally long, and sometimes so contracted at its orifice that it is impossible either to expose the glans penis or to effect retraction without much difficulty and pain. The skin is abundant, but the mucous membrane is shorter than usual, and the narrowing which prevents the retraction is always found at the junction of the skin and mucous membrane. Congenital phimosis is a fertile source of irritation and disease. Even when the prepuce is simply elongated, and not sufficiently contracted at its orifice to prevent its withdrawal from the glans, it still favours the retention of the secretions beneath it, which may result in balanitis. But, short of this, there can be no doubt that an elongated prepuce is frequently the cause of much local irritation, leading to the habit of masturbation. When, however, the orifice of the prepuce is so narrow as to prevent retraction, the results are of a much more

serious nature. One of the most common symptoms is nocturnal incontinence of urine, which frequently resists all attempts at cure short of circumcision.

Occasionally the long, contracted prepuce acts as an impediment to the passage of the urine, and gives rise to symptoms resembling those of stone in the bladder. In very extreme cases of this sort, the prepuce becomes enormously distended by the retention of the urine beneath it, requiring the pressure of the hand to extrude it through the orifice. The severe straining to void the urine under these circumstances is a frequent cause of hernia in young children, and it is also stated that hydrocele and phimosis are often associated. The effect of this deformity on the nervous system has been noticed by Professor Sayre of New York, who states that paralysis of the lower extremities is often a direct result of the irritation caused by congenital phimosis. Erichsen also states that he has seen cases of chorea arising from the same cause. In after-life the evils of phimosis are not abated. There is no doubt that the immunity from chancreous affections, known to exist amongst the Jews, is due to the rite of circumcision, and it is inferred, from the statistics collected by Jonathan Hutchinson, that a long prepuce renders its possessor more liable to the infection of syphilis. At any rate, it makes the treatment of venereal disease more difficult, and in some cases impossible without recourse to an operation.

Congenital phimosis is sometimes a complete bar to sexual intercourse, or even when connexion has been effected, conception is prevented owing to the retention of the seminal fluid beneath the foreskin. It has been asserted, without much foundation, that this malformation predisposes to cancer of the penis.

Acquired phimosis is the result of inflammatory deposits in the prepuce, caused generally by balanitis, chancre, or repeated attacks of herpes preputialis. When it results from a balanitis the swelling is simply oedematous, accompanied by a profuse purulent discharge from the orifice of the prepuce. If, however, it is due to indurated chancre, a point can generally be felt beneath the prepuce more painful and indurated than the surrounding tissue. See **BALANITIS**. In advanced life, the preputial orifice will be found sometimes contracted from repeated attacks of herpes, especially in gouty subjects.

The *treatment* of phimosis, whether congenital or acquired, generally requires surgical interference. In congenital phimosis,

there can be no doubt as to the propriety of circumcision in all cases of elongated prepuce with contracted orifice; and the necessity for the operation should be represented to parents even in the absence, at the moment, of painful symptoms. In simple elongation, if there is the least difficulty in exposing the glans, it is better to err on the side of operative interference.

If phimosis is associated with nocturnal incontinence of urine, it is far better at once to circumcise the child than to waste time in the constant administration of the various remedies prescribed for this condition. In cases of sexual incapacity, an elongated prepuce may frequently be shortened with good effect, and certainly, if with the elongation there is contraction of the orifice, circumcision should be recommended. Phimosis, the result of a balanitis, may of course be reduced by simple remedies, such as fomentations, hot baths, and injections; but if there is suspicion of a chancre beneath, it is better at once to expose the glans by the slitting operation. *See* CIRCUMCISION.

In cases of acquired phimosis, especially in old men, the malformation may frequently be remedied by dilating the parts either with a pair of forceps, or by a screw dilator especially constructed for the purpose. The operation may, in some cases, be facilitated by incising the orifice at two or three points with a narrow-bladed knife. PAUL SWAIN.

PHLEBITIS.—An inflammation of the veins.

Causation and Pathology.—The most purely surgical form of phlebitis is that induced by wound or contusion—traumatic phlebitis. The idiopathic form most nearly resembling this is that occurring after parturition, where the inflammation in like manner spreads directly from the open mouth of ruptured vessels, subsequently to separation of the placenta. Apart from this, acute phlebitis is almost invariably secondary either to thrombosis or inflammation of the surrounding structures, the primary changes in the former case taking place in the inner coats, in the latter in the adventitia, later becoming general. Chronic inflammatory changes may, as in the arteries, be primary, and are then due to anomalies in the force and rapidity of the venous circulation; as would be expected, however, from the less variable nature of these conditions in the veins, chronic endo-phlebitis is a much less common or serious disease than the corresponding arterial change. The inflammation may be local or adhesive, diffuse or

suppurative, in character. Gouty and tubercular phlebitis are also spoken of.

Adhesive phlebitis is seen in its purest form in cases of wound. By this process the necessary obliteration is effected after wound; it is seen also in cases where thrombosis is followed by organisation. *See* HÆMORRHAGE; THROMBOSIS. Suppurative phlebitis may be secondary to suppurative of a thrombus, or to extension of inflammation from without. It is diffuse in character, and its causation resembles closely that of pyæmia. When periphlebitis occurs secondarily to cellulitis, the adventitia is principally affected; the vein is often dissected out by surrounding suppuration, and under these circumstances may slough. This is of importance, as in these cases complete thrombosis is often absent, so that hæmorrhage may result. The coats of the vein are thickened by infiltration with inflammatory new-formation, stiff, of a yellow or yellowish-grey colour, the intima opaque and more or less deeply tinged with red. This condition may extend over a large area. Besides the diffuse form of suppurative phlebitis, localised suppuration may occur in cases of adhesive phlebitis, either the clot breaking down at its centre or the change being entirely perivenous; in these cases, a well-developed clot usually exists on either side of the suppurating point, excluding the dangers of septic infection and hæmorrhage. Chronic endo-phlebitis is most common in cases of varix; usually the veins here are generally thickened, and, on examination, the intima may be more or less opaque, presenting in addition ill-defined yellowish patches, slightly raised by infiltration beneath. These patches of fatty or atheromatous degeneration are often accompanied by the presence of small calcareous spicules. In acute miliary tuberculosis, tubercles may be deposited beneath the intima, and in chronic tuberculosis of organs, the veins may become implicated by direct extension. Should a breaking-down mass in this way directly open into the general circulation, it may be the source of a general miliary tuberculosis (Weigert). No special pathology yet exists for the gouty phlebitis of Paget, who says 'the evident disposition towards being metastatic and symmetrical . . . is strongly in favour of the belief that the essential primary disease is not a coagulation of the blood, but an inflammation of portions of the venous walls.'

Symptoms.—These differ widely according to the local, or diffuse and septic character of the inflammation.

LOCAL PHLEBITIS.—This is most frequently met with secondary to injury, or in cases of varix, and then in the lower extremity. The first symptoms are usually pain and swelling, accompanied by interference with the function of the limb; the other cardinal signs of inflammation, heat and redness, will be present in varying degree. Pain, increased by use of the limb, in some cases slight, in others of a severe neuralgic character, often severe in thrombosis of deep veins with subfascial œdema. Swelling, due chiefly to œdema, in part to inflammatory changes in and around a vein. The character of the swelling varies with the affection of superficial or deep veins. If the superficial veins, there is local œdema of the area from which the blood-supply is gleaned, and a hard cord or knotty tumour corresponds to the thrombosed vein. If the deep veins, there is general œdema of the limb, of a tense white character, often not sitting on pressure, and accompanied by considerable enlargement of the superficial veins. Redness, of a bright or purplish character, may extend over the thrombosed veins, if superficial; it is usually developed subsequently to the pain and swelling. The temperature of the limb may be raised generally, or locally over the patches of inflamed veins. When local suppuration occurs, the usual signs of abscess-formation will be present.

These local symptoms will be accompanied by those of a general febrile condition of varying intensity, usually not severe, the temperature rarely rising above 100° or 101° Fahr. The marked characteristics of the symptoms in gouty phlebitis are the tendency to metastasis, already referred to, and its patchy distribution.

DIFFUSE SUPPURATIVE PHLEBITIS.—In these cases we have the signs of diffuse cellulitis, accompanied by symptoms of general infection. The most frequent examples of the condition are met with in pyæmia; hence, it occurs frequently in like manner after injury to bones or veins. It may start from a wound, or may occur without any local breach of surface. The local signs again depend on the superficial or deep situation of the vein affected: if superficial, there will be œdema, diffuse, dusky redness and pain, often unaccompanied by local evidence of clot-formation, followed by rapid suppuration and extensive sloughing. If the deep veins are affected, superficial discoloration may not occur, but actuation and signs of deep suppuration appear early; in some cases, gangrene of the whole thickness of a limb may rapidly

supervene. The general symptoms are those of septic cellulitis with constitutional infection. The temperature is continuously high, as in septicæmia (103°, 104°, 105° Fahr.), or there are frequent rigors when metastases occur. The patient is depressed, sleeps badly, is often delirious, the delirium being of a wandering character. The tongue is furred and dry, the teeth and lips become rapidly covered with sordes, diarrhœa often sets in, and the patient dies in a typhoid condition.

Prognosis.—In adhesive phlebitis the prognosis is good as to life, and, locally, permanent obstruction of the vein is uncommon except in the case of varicose veins; here such a result is to be regarded favourably, as effecting a spontaneous cure. If the vein is obstructed and sufficient collateral circulation is not set up, permanent œdema may more or less interfere with the functions of the limb. Diffuse suppurative phlebitis is, on the other hand, extremely serious, the patient as a rule dying of SEPTICÆMIA or PYÆMIA.

Diagnosis.—The diagnosis of phlebitis from simple thrombosis depends on the absence of local or general inflammatory symptoms in the latter. Lymphangitis presents considerable resemblance to phlebitis. The chief distinguishing points are—(1) the primary origin—in lymphangitis in a sore, in phlebitis often in a varicose vein; (2) the early enlargement of glands in lymphangitis; (3) the bright rosy tint in lymphangitis, appearing prior to the œdema, also its tendency to spread in a spiral line, in phlebitis the tint usually being darker, the blush appearing subsequently to the œdema; (4) the extent of the œdema in phlebitis; (5) the presence of a hard cord in phlebitis.

Treatment.—The treatment consists in giving rest to the part, and affording all possible aid to the impeded circulation. The patient should be confined to bed, the limb raised, and loosely bandaged. If there be much pain, the limb may be enclosed in warm cotton-wool sprinkled with belladonna liniment, or with lint on which equal parts of belladonna extract and glycerine have been spread. The bowels should be kept acting freely, and any source of constriction or vein-pressure, if possible, removed. In the later treatment, elastic pressure, to support the limb and promote absorption of effused inflammatory products, should be employed. In the case of thrombosis, a piece of emplastrum ammoniaci c. hydrargyro, applied over the spot, often promotes absorption. In cases of diffuse suppurative phlebitis, treatment is of

little avail; stimulants must be given freely, and if the removal of the inflamed area be possible, amputation may be performed to remove the local infecting centre.

G. H. MAKINS.

PHLEBOLITH.—A calcareous concretion developed within a vein. Phleboliths are the result of calcareous degeneration of laminated thrombi; they are met with chiefly in the veins of the lower extremity and pelvis, most commonly lying loose in ampullæ behind the valves. They are usually rounded or oval in shape, and are constituted of phosphate of lime with twenty per cent. of protein matter and a little sulphate of lime and potash (Frankland).

G. H. MAKINS.

PHLEBOTOMY. See *VENESECTION*.

PHLYCTENULAR OPHTHALMIA.
See *CONJUNCTIVA*, Diseases of the.

PHOSPHORUS NECROSIS. See *JAWS*, Diseases of the.

PHOTOPHOBIA, a dread of light, is a common symptom of inflammation or other disease of those parts of the eyeball and its appendages which are innervated by branches of the fifth nerve. See *CONJUNCTIVA*, Diseases of the; *CORNEA*, Inflammation of the; *IRIS*, Diseases of the.

PHTHIRIASIS.—The eruption produced by lice. See *PEDICULL*.

PIGEON-BREAST.—A malformation of the anterior walls of the thorax, which may result from various causes. The upper half of the thorax may be quite normal, but from sudden depression of the infra-mammary regions after whooping-cough, partial collapse of the lungs, &c., the lower half of the sternum, with the contiguous rib-cartilages, become unduly prominent.

Another variety, which best deserves the name of pigeon-breast, is when the whole thorax is much narrowed from side to side, with the sternum presenting, instead of a plane surface, a convex one transversely; this is apparently of congenital origin, but becomes worse as the child grows.

A third variety is due to giving way or bulging of the sternal rib-cartilages, leaving the sternum in a hollow; sometimes there is actual hollowing out of the sternum, exactly reproducing what is known as boot-maker's chest, which is the effect of the pressure of the 'last,' against which the man presses while at work. This variety is more often unilateral than the others, as the

rib-cartilages on one side may be quite normal, while those on the opposite side project an inch or more beyond the normal surface of the thorax. The anterior ends of the sternal ribs may participate in this bulging of the rib-cartilages.

A variety of pigeon-breast accompanies severe spinal caries, with much deformity of the dorsal vertebræ; here the sternum is thrust forwards, especially its lower half, with the adjoining rib-cartilages and ribs.

Pigeon-breast, not due to spinal caries, is nearly always associated with exaggerations of the antero-posterior curves of the spine (see *ANTERO-POSTERIOR SPINAL CURVATURE*), and is not infrequently found in lateral curvature.

Pathology.—In opposition to some authorities, who maintain that pigeon-breast is always due to rickets, Sir W. Jenner says that 'it very often arises from other diseases than rickets, but the two varieties are very easily distinguished. In rickets, the deformity is due to the softening of the bones, which yield at their growing ends and push forward the sternum as a rounded prominence, and the outline of the chest is a double curve. In pigeon-breast from non-rickety causes, the yielding of the ribs takes place where there is a natural maximum bend—at their angles, the sternum is pushed straight forward, and the outline of the chest is angular' (the pigeon-breast of spinal caries *par excellence*). It is, therefore, due to rickets and other affections causing softening and yielding of the bones, especially when associated with lung-trouble, as acute and chronic bronchitis, whooping cough, &c.; also with partial collapse of the lungs, caused by deficient expansion of the thoracic walls from enlarged tonsils obstructing the entrance of the air into the lungs.

This deformity is nearly always one of infancy and childhood, and is often overlooked until it gradually becomes so bad as to attract attention.

The *prognosis* as to the effect of treatment depends upon the amount of improvement immediately effected by placing the patient in the erect position, with the arms extended upwards by the side of the head. Apparently very deformed cases, especially when due to falling-in of the infra-mammary regions, can thus be almost completely restored temporarily to a normal configuration. The earlier treatment is commenced, and the more yielding the chest-walls, the more satisfactory will be the result.

Treatment.—Nothing can be done for the deformity of pigeon-breast due to spinal

caries; but considerable relief can be given to the patient's want of breath and sense of fatigue, by developing those portions of the thorax which are still movable, by means of the treatment described below. Necessarily, the spinal caries must be cured by healthy bony ankylosis before attempting anything for the chest-trouble.

In pigeon-breast due to other causes, the first thing is to correct any spinal deformity present (*see* LATERAL and ANTERO-POSTERIOR SPINAL CURVATURE). The next is to enlarge the thorax anteriorly by means of the pectoral muscles, which is efficiently carried out, as follows:—The patient, lying supine, with a small longitudinal pillow between the scapulæ, fixes himself by flexing the knees over the end of the padded table on which he lies, or the pelvis is held on each side by an assistant: the arms are extended upwards by the sides of the head. The surgeon, grasping the hands, resists while the patient slowly flexes the elbows, which should touch the table the whole time, and adducts the upper arms till they are at right angles to the trunk; the patient then slowly relaxes, while resisting the surgeon's efforts to extend the arms to their original position on each side of the head. This exercise is slowly repeated twenty or thirty times, and has frequently a wonderful effect in restoring for the moment a properly shaped thorax. The same exercise can be as readily done by the surgeon sitting with the patient kneeling in front and leaning back against the surgeon's knees, kept close together, covered by a pad or cushion which fits the patient's back between the scapulæ.

Another exercise, to be recommended, is hanging by the hands with the spine and sacrum in contact with the wall, to which are fixed the two pegs the patient grasps; he has then to rotate the spine alternately to the right and left a dozen times. Great care must be taken that no article of clothing is so tight in front as to interfere with the resumption of an improved thorax. Systematic respiratory exercises are most beneficial. In some cases, the surgeon should press in with his hand any undue prominence of the sternum, cartilages, or ribs, while the depressed portion of the thorax is being elevated by any of the above described exercises. If benefit is to be obtained from treatment, a decided improvement will be effected at the end of a month.

The writer saw Dr. Monti of Vienna, some eight years ago, treating pigeon-breast by placing the child in an air-tight bath connected with an air-pump, the face only

of the child being uncovered and surrounded by a broad band of india-rubber. By exhausting the air in the bath the thorax expanded, and, by repeating this daily, considerable improvement was obtained.

BERNARD ROTH.

PILES. *See* HÆMORRHOIDS.

PINGUECULA is the name given to a small yellowish elevation in the conjunctiva near the margin of the cornea, usually at its inner side, more rarely at its temporal margin, but sometimes in each place. It contains, notwithstanding its name, no fat, but is composed of connective tissue and elastic fibres. It is supposed to be due to the irritation caused by small foreign bodies. It rarely grows to a large size, and requires no treatment unless it becomes disfiguring, when it may be removed with forceps and scissors.

H. R. SWANZY.

PIROGOFF'S AMPUTATION. *See* ANKLE-JOINT, Amputation at the.

PISTOL SPLINT.—This has the shape indicated by its name; it is used for Colles' fracture of the radius. The handle is first fixed to the hand and lower fragment, and then the portion corresponding to the barrel is raised to the line of the forearm; by this means the hand is adducted. A short anterior splint, reaching from the elbow to the lower end of the upper fragment of the broken bone, is used with the pistol splint, which should be applied to the posterior surface of the limb.

PITYRIASIS.—The name pityriasis (*P. simplex*) has ceased to convey any definite meaning to the dermatologist, and has rightly dropped out of use altogether. The older writers applied the term to any scaly condition of the skin, the nature of which they did not clearly understand. It may be stated definitely that there is no such disease as pityriasis pure and simple; all the cases so called are simply the later stages of some other disease, such as eczema, steatorrhœa, or lichen scrofulosus.

Pityriasis rubra is a name still in use for a form of exfoliative dermatitis, first described by Hebra, who drew careful distinctions between it and other forms of general exfoliative dermatitis, such as eczema squamosum, general psoriasis, and lichen ruber. The question as to whether or not Hebra was right in his conclusions is still *sub judice*. It is probable, however, that the majority of dermatologists of the present day agree with the late Dr. Baxter

in regarding pityriasis rubra as a very severe form of dermatitis, which may develop from squamous eczema, psoriasis, or lichen, the distinctive characters of these diseases being ultimately lost altogether. With this view the writer in the main agrees. If further observations prove that Dr. Baxter's conclusion is right, it will lead to the general adoption of the name 'exfoliative dermatitis' instead of 'pityriasis rubra,' so that we may ultimately get rid of the word 'pityriasis' altogether. Whatever name, however, we adopt, the disease is both serious and characteristic. In typical cases, the whole body is affected from the sole of the foot to the crown of the head, the skin itself is highly congested, but not thickened nor infiltrated; it is covered with imbricated scales of epidermis, often arranged in wavy rows like scale armour. The dead cuticle sometimes peels off in large pieces, but more commonly the scales shed are small and branny. The degree of exfoliation varies, but it is generally very great, so that a pint measure may sometimes be nearly filled with the scales which rub off in the course of twenty-four hours. The nails generally become uneven and opaque. There is always tenderness of the skin, so that contact with anything gives pain. Itching is not present in all cases. Associated with this condition of the skin, there is always considerable constitutional disturbance and greatly enfeebled vital powers. Not uncommonly there is albuminuria; it has been present in about three-fourths of the cases that have come under the observation of the writer. The *prognosis* in severe cases is unfavourable, a large percentage ending fatally.

Treatment.—This is usually very unsuccessful. Tonics, good food, and rest in bed are, of course, indicated. Simple lotions, such as the linimentum calcis, sometimes give a little local relief to the pain and tenderness of the skin. • ROBERT LIVEING.

PITYRIASIS VERSICOLOR.—*Definition.*—A discoloration of the skin produced by the presence of a vegetable parasite.

Symptoms.—It differs from the other skin-diseases produced by vegetable parasites in that it is harmless, very slightly if at all contagious, and attacks adults rather than children. It occurs usually on the chest and back, in patches of variable size of a yellow or fawn colour, and more or less symmetrical though rarely covering the part uniformly. The patches are slightly raised, and covered, especially at the mar-

gins, with fine powdery scales; and on examination with a lens, the mouths of the hair-follicles will be seen to be much affected. As a rule there is no itching, but very occasionally it is severe. The disease may last for years, and, being harmless, it is only on æsthetic grounds that any treatment is called for. Sweating seems rather to encourage the growth of the parasite, which fact accounts for its prevalence among consumptive patients.

Diagnosis.—It may be mistaken for a secondary syphilide. Other symptoms of syphilis should be looked for, and, should there still be doubt, a careful microscopical examination of scales from the patch would settle the point. The presence of fungus, the scaliness of the patch and its restriction to covered parts, will serve to distinguish it from chloasma; which moreover usually occurs on the face.

Pathology.—Scales, scraped from the patch and placed in dilute liquor potassæ, show, under the microscope, a network of mycelium branching in all directions and groups of large, well-defined spores. The arrangement of the spores in groups is quite characteristic of this fungus, which is known as the *microsporon furfur*.

Treatment.—Thorough friction with soft soap, and the application of any parasiticide. A lotion composed of hyposulphite of soda, 3j. to f3j. of water; or sulphurous acid, 1 part to 4 of water freely applied, or linimentum iodi painted on will easily cure in a few days. If the disease reappears, it is because some particles of the fungus are still undestroyed in the hair-follicles, hence it is necessary to apply the remedies with some energy, and continue them after all apparent signs of the disease are gone. MALCOLM MORRIS.

PLANTAR ARTERIES, Wounds of. These are naturally, owing to the protected condition of the feet, much more rarely met with in this country than wounds of the palmar arches.

Treatment.—This, as in the case of the hand, will vary accordingly as the surgeon is called at the beginning or later on in the case. In the former instance, unless severe hæmorrhage is going on, the effects of careful pressure should first be tried. Thus the surgeon need not spend much time in exploring the wound, but, the main trunks being compressed above, it should be cleaned, and a graduated compress applied, the lint nearest the wound being soaked in Tr. Benzoini Co., carbolic oil, or some styptic, or dusted with iodoform. Before this com-

press is finally secured tightly *in situ*, the toes and foot beyond the wound must be carefully strapped and bandaged, to prevent the painful cedema which is otherwise certain to occur, and which will lead to removal of the compress and recurrence of the bleeding. The compress may be kept *in situ*, by means of two parallel pieces of wood, one above the foot and one below, the two ends of which project on either side, and are secured by strips of handkerchief as in Völcker's plan; and this method will be found useful where no strapping is handy, or where the patient has to be moved any distance. When the patient is in bed, the foot and leg should be kept quiet on a splint, and, if possible, slung in the raised position, with the knee bent, morphia being given subcutaneously. If the surgeon lives at any distance from his patient, it will be well to mark out the femoral artery at the apex of Scarpa's triangle, and to leave a tourniquet very lightly applied.

If hæmorrhage recurs, which is not likely if a compress has been properly applied from the first, the surgeon has to choose between ligature of the dorsalis pedis and posterior tibial arteries, on the dorsum of the foot and behind the inner ankle respectively, and ligature of the femoral at the apex of Scarpa's triangle. The former is by no means certain to prevent recurrence, as the anterior peroneal and internal calcanean, by their anastomoses with the malleolar, tarsal, and plantar arteries, will still bring in blood. Thus, ligature of the femoral will be the more certain method, but this step can only be called for under very rare circumstances.

Where the surgeon is not called to the case till some days after the accident, when recurrence of hæmorrhage is complicated by cedema, cellulitis, and suppuration, and persists in spite of relief to the tension by incisions, the elevated position, and such applications as iced lead lotion, ligature of the femoral is justified, not only for arrest of hæmorrhage, but as likely to cut short the inflammation. W. H. A. JACOBSON.

PLANTAR FASCIA, Contraction of the.—Unlike the corresponding fascia in the palm, that of the foot is very rarely found contracted except in association with certain forms of talipes. Occasionally, however, it is met with either as a congenital affection, though not always marked at an early period of life, or in association with paralysis of the interossei, giving rise to the condition known as 'pes cavus.' At first the deformity is not marked, but, as

the contraction increases, the relation of the bones of the tarsus becomes altered, and the weight of the body having to be sustained entirely upon the heel and the ball of the toe, pain becomes frequent after prolonged exertion or standing. The remedy is to be obtained by freely dividing the contracted fascia subcutaneously, and by the application of a Scarpa's shoe, which should be so constructed as to raise the anterior half of the sole, and to press upon the increased prominence which is given to the dorsum of the foot by the altered position of the bones. This must also be assisted by a strap and buckle passing over the dorsum, and applied to the boot which is to be worn by the patient. See CLUB-FOOT.

JOHN H. MORGAN.

PLASTIC SURGERY.—The various operations of plastic surgery are designed for the restoration of functional usefulness, or for the removal of disfigurements. Of the defects in question, some are due to developmental errors—e.g. cleft palate, hare-lip, extroversion of the bladder, and hypospadias; some to the ravages of disease, such as the destruction of the nose by syphilis or lupus; and others to the immediate or remote effects of physical injuries, as is seen in ruptured perineum and in cicatrices from burns.

There are certain conditions essential to the success of operative procedure:—(1) The tissues concerned must be in a healthy state. It would be useless attempting to fashion a nose where lupous ulceration was still in progress. (2) When the deformity is the consequence of constitutional disease, the surgeon must take care that the general health is such as to warrant the expectation of the wound healing by first intention. Marked syphilitic cachexia contraindicates the performance of operations otherwise expedient. (3) All *tension* upon the parts must be prevented. There are different ways of carrying out this principle. The strain from muscular action is avoided in some cases by division of the muscles. Thus the tensor and levator palati are occasionally cut in the operation for cleft palate, and the sphincter ani in the treatment of fistulous openings involving the rectum and vagina. As a rule, however, it is sufficient if physiological rest is ensured—e.g. by keeping the bowels confined and a catheter in the bladder for several days after suture of a ruptured perineum. In plastic operations about the neck, the head should be fixed by a suitable mechanical appliance. It may be advisable, where the

gap to be bridged over is very wide, to put in deep sutures for the purpose of taking off the strain on the superficial ones. When the operation is for the removal of extensive contraction from burns, subcutaneous division of cicatricial bands skirting the main scar is of great service. In certain instances, lateral incisions are employed to facilitate the coaptation of the freshened edges of clefts or fissures. In the hard palate, e.g., the mucous membrane and periosteum are divided and raised from the underlying bone to allow of easy apposition to the margins of the cleft; or, instead of this, the bony plate is chiselled through, and the septal process in its entire thickness carried inwards on each side in order to secure freedom from tension.

In transplanting skin, as in the construction of a nose, or in the covering in of an extroverted bladder, the flaps should be cut considerably larger—generally about one-sixth—than the spaces they are intended to fit, since otherwise the shrinking from elasticity might entail partial or entire failure of the undertaking. Care must be taken that the bleeding has ceased before the edges are brought together, as the interposition of a blood-clot would tell against the chances of primary union, which is of paramount importance in all plastic operations. For the same reason, foreign bodies should be scrupulously excluded. The raw surfaces are to be brought into accurate apposition, and fixed *in situ* by numerous fine sutures knotted on the sound tissue. If it is deemed desirable, additional means of support can be provided.

The *after-treatment* consists chiefly in keeping the wound protected from injury, and free from the irritation of septic matter. It is a good plan, when practicable, to cover the part with oiled silk, and this with moistened boracic acid lint or iodoform wool. To retain the dressings in place, collodion is preferable to strapping, as it exercises no injurious pressure, whilst it more effectually prevents the ingress of atmospheric impurities. Where the wound, however, is of mere linear extent, it is sufficient to support it, and paint it over with flexile collodion. It may be mentioned that where healing by the first intention is not obtained throughout the entire wound, cicatrization should be encouraged by grafting, snippings being taken from the skin for that purpose.

After union has taken place, attention should be directed to the cicatrix, which is liable to undergo stretching on the one hand and undue contraction on the other.

Either of these events may frustrate the purpose the surgeon had in view.

Causes of Failure.—Neglect of one or more of the above-mentioned provisions may end in want of union, primary or secondary. Other causes of failure are erysipelas and secondary hæmorrhage, accidents to which all wounds are liable. In transplantation of skin there is always some danger of sloughing, consequently, when gliding or torsion is employed, it is necessary that the pedicle or base of vascular supply be of ample width, in order that the vitality of the flap may be ensured.

Methods of Procedure.—The primary plastic operations fall practically under five heads, three of which relate to transplantation of pieces of skin from adjacent or distant parts. (1) The Italian or—as it is named after the surgeon who introduced it—the Tagliacotian method consists in freshening the surface and margin of the area to be covered, and fixing there a flap of skin raised from another part of the body; thus, in the construction of an eyelid, the graft is taken from the hand, which is kept applied to the face until the supply of blood from the pedicle of the flap is no longer required. The pedicle is then divided. The operation is seldom practised, since it necessitates restraint of movement, which is irksome to the patient. It has one advantage—viz. the pedicle can be made as wide as desired, so that sloughing is effectively guarded against. (2) The Indian operation is generally selected in preference to the Italian. The flap is dissected from the skin immediately bounding the part to be constructed or restored, and is placed in position either by gliding or torsion. The latter plan is carried out in the operative treatment of ectopia vesicæ. Burow's operation combines excision and gliding, the object being, not only to close a gap in the skin, but also to minimise and distribute the unseemliness resulting from contraction of the cicatrix. It is admirably adapted for the removal of scars and rodent ulcers of moderate size. (3) Wolfe has shown that portions of skin can be successfully excised and grafted on to freshened surfaces. He recommends that all the subcutaneous fat and areolar tissue from the graft should be removed with scissors. The operation must be performed rapidly, and with scrupulous attention to cleanliness. (4) Fissures or clefts are closed by freely paring the edges, bringing them into accurate apposition, and fixing with sutures, harelip-pins, &c. (5) Fistulous openings are usually treated by paring the

edges, raising the skin from the subjacent tissues, and causing it to glide over the aperture to be obliterated. See RHINOPLASTY.

Recent experiments have shown that, in the lower animals, strips of bone with the periosteum attached can be successfully grafted on to living tissues, where they are capable of setting up osteoplastic growth. It remains to be seen how far this measure will be serviceable in the surgery of the human being. See GRAFTING.

AUGUSTUS J. PEPPER.

PLEUROSTHOTOS. See TETANUS.

PLUGGING THE NOSTRILS. See EPISTAXIS.

PNEUMOCELE, or HERNIA OF THE LUNG, is the protrusion of a portion of the lung through a wound involving the pleura. It is divided into the *immediate* and *consecutive* forms.

In the *immediate* form, the lung protrudes directly from the wound, either immediately after the injury or within a very short period. It may be complicated by a wound of the lung, though this is not a necessary accompaniment. It probably arises from the patient making a powerful expiratory effort, with the glottis closed, at the time of the receipt of the injury, the thoracic wound itself being almost necessarily an incised one. The air not being able to escape from the lung, this viscus itself is forced in the direction of least resistance, which will be through the wound. When expiration takes place, the ribs descend, the intercostal spaces narrow, and the piece of lung extruded remains shut out of the cavity of the chest. As the circulation in the blood-vessels, more especially in the veins, gets impeded by the pressure, rapid swelling of the extruded mass takes place, and the hernia becomes irreducible. Under these circumstances it presents a bluish-black mass, which consists of the lung covered over by its own investment of pleura; this, as the congestion becomes greater, assumes almost a black appearance. It generally, however, retains its vitality for a lengthened period, but may, if the congestion be very intense, die and slough off at the point of constriction, leaving a granulating sore which pretty readily cicatrises. The lung remains adherent to the parietes at this spot.

Treatment.—The prognosis in these cases is favourable. If the patient be seen sufficiently early, an attempt may be made by gentle manipulation to reduce the hernia, great care being taken not to damage its delicate vesicular structure in so doing. If

this be found impossible, the neck of the constriction may be cautiously divided on a director, care being taken to avoid wounding the intercostal vessels. The manipulation for reduction should then be repeated. The advisability of reducing the hernia must necessarily depend upon the state of the extruded piece. If the congestion be very intense, leading to the belief that there will be great risk of sloughing, it will be best to leave it *in situ* to separate by the natural processes. Or, if these are too long and tedious in their course, they may be expedited by surrounding the protruded mass with a ligature, or even by cutting it off. In the latter case the risk of hæmorrhage is considerable, unless the process of sloughing has already proceeded so far as to obliterate the vessels.

In the *consecutive* variety of hernia of the lung, the protrusion does not take place till some weeks after the infliction of the injury, when the wound is already cicatrised. The hernia will here be covered over by the thinned integuments, forming a doughy, pulpy mass of the normal colour of the skin. The manner of its production is probably the following. The wounded lung becomes adherent at the point of injury, which undergoes a chronic inflammatory process all around, and hence, as all inflamed tissues are weaker than healthy ones from having lost their resisting power, the whole area of the chest parietes about the wound will be weaker than usual. The lung itself, from constant coughing, as well as from the injury, becomes swollen and emphysematous, and hence tends to protrude in the direction of the least resistance, which will be towards the injured part; where its constant pressure may even cause absorption and thinning of the parietal structures, just as an aneurism does.

The *prognosis* of cases of pneumocele is favourable. The *treatment* consists simply in protecting and supporting the hernia. This may be done by some variety of truss, contrived specially to suit the nature of the case.

A special form of immediate pneumocele is occasionally seen without external wound, when the walls of the chest have been so badly crushed that the ribs have become comminuted. The intra-thoracic injury in these cases is so severe as almost always to lead to rapid death.

Congenital pneumocele is also sometimes seen. The affection is very rare, and the treatment will be the same in principle as for the consecutive variety.

H. G. HOWSE.

PNEUMONIA, Traumatic.—Inflammation of the lung, from injury to this viscus, may be due either to an external wound, to a wound produced by a broken bone, or to the harm wrought in the organ by a severe squeeze, whether producing actual rupture of the tissue or falling short of that point. The symptoms are much alike in all three cases, but the prognosis will be much more grave in the case of an external wound than in the other two, in which, as a rule, the prognosis may be regarded as favourable, if the amount of tissue involved be not very great.

The *signs* of an acute pneumonia, occurring after injury, will be much the same as in idiopathic pneumonia. But it will generally be preceded by the expectoration of frothy, light-red blood from the injured part of the lung; and this will gradually change, in from thirty hours to three days, to a rust-coloured sputum, as the pneumonia becomes established. In an ordinary acute idiopathic pneumonia, there is not the same expectoration of frothy, light red blood. There may be a small amount of white frothy sputa in such cases, but this very rapidly changes to rust-coloured expectoration. In cases of doubtful injury this may help to clear up the point, though it is not an absolute rule.

In addition to the expectoration, there will be dulness over the affected part of the lung; this may spread far beyond the actual injury. Auscultation will give in the first place a fine silky crepitation, due probably to the blood effused in the vesicular tissue of the lung,—but rapidly changing to coarse crepitant râles, as the lung becomes solid and permits the movement of the air and mucus in the large tubes to become audible. There will then be more or less bronchial breathing and bronchophony audible over the affected part, and the vocal fremitus will be increased. In the severer cases, the temperature may rise to 102° or 103° F., and the pulse in proportion. The respiration will be hurried out of proportion to the pulse, on account of the diminished breathing area available. In cases such as these, it is obvious that the disease may pass on to a fatal issue, if the injury be severe and the amount of lung implicated be considerable. More especially is this likely to be the result, if the condition of the other viscera (kidneys, liver, &c.) be not perfectly sound at the time.

The *prognosis* in these cases is generally favourable, if the amount of lung-tissue involved be not very great. The dulness

becomes less marked; air is again heard entering the vesicular tissue on auscultation, the bronchophony and bronchial breathing disappear, and the expectoration loses its rusty colour and finally ceases.

The *treatment* of these cases does not require to be of an active nature. In the first stage, that of hæmorrhage from the lung, it will be necessary to give the patient as little food as possible, so as to limit the tendency to extravasation of blood. The length of the subsequent affection, and its severity, will very much depend upon the amount of blood effused, and the area of lung-tissue thus involved. The patient should be kept in bed, and at perfect rest, and the tendency to cough diminished as much as possible. In the second stage, when the hæmorrhage has ceased, this may be aided by keeping the patient in a warm moist atmosphere. The writer has found that nearly all hospital patients, in this condition, experience great relief from being placed in a tent with a steam-kettle. During both the first and second stages, benefit is derived from the administration of antimonial wine in some such form as the following:—℞ Vini antimonialis ℥x.; Tinct. camph. co. ℥xx.; Liq. morphine hydrochlor. ℥xx.; Liq. ammoniæ acet. f3ss.; Aq. chlorof. ad f3j. Ft. haustus, quartis horis sumendus.

In the last stage, that of resolution, all medicine may be suspended, and the inflamed lung allowed to take its own course. Even in this stage the diet should be very carefully regulated, for the resolution of a considerable mass of inflamed tissue is a tax upon the powers of elimination, and hence involves work for the excretory glands, which, if not in a perfectly sound condition, they may have a difficulty in performing.

Should the pneumonia be due to an external penetrating wound, the treatment would be that described under the head of LUNG, Wounds of the. H. G. Howse.

PNEUMOTHORAX is the condition in which air fills the pleural cavity, the lung collapsing to a degree corresponding to the amount of air entering the pleura. In medical practice, it is most frequently caused by disease of the lung of an ulcerative character—e.g. the perforation of a tubercular cavity into the pleura, or by gangrene of the lung. In surgical practice, cases mostly arise from external injury, the air either entering from without, as in perforating wounds of the thoracic parietes; or from the lung itself, where this viscus

has been wounded. These wounds may be caused either by the pointed end of a fractured bone, most commonly a rib, or by some external penetrating agent.

Pneumothorax is more common in the adult or those past middle age than in young people. The reason of this is that, where the lung is healthy, there is less tendency in the surfaces of the pleura to fall away from each other than where atrophic or senile changes are impending. Thus, in some incised wounds of the chest, where the lung is clearly exposed, pneumothorax does not take place, the exposed lung remaining in apposition with the sides of the wounded pleura, and moving in each act of respiration. In such cases, the coaptation of the surfaces of the pleura seems to neutralise the natural tendency of the lung-tissue to contract. In paracentesis thoracis for serous effusion in young people, the tendency to pneumothorax is much less than in the same operation for empyema. The reason of this probably is, that in cases of empyema the lung itself more frequently becomes diseased, and hence loses its elastic resiliency, while the tendency to elastic contraction becomes proportionably greater.

The *signs* of a pneumothorax, whether resulting from disease or accident, are similar, and cannot well be overlooked in any careful examination of the chest. In the first place, there is drum-like resonance on percussion over the whole of the chest. The only exceptions to this rule are where a previous pleurisy has caused partial adhesions of the pleura, so that the pneumothorax does not spread over the whole of the pleural cavity. In such cases, there may be local tympanitic resonance, but elsewhere the ordinary percussion note of the lung is present. On the other hand, tympanitic resonance is very often found in the upper part of the chest-cavity anteriorly, where there is serous or purulent effusion in the pleura without any pneumothorax. This is due to the lung being pressed up towards this part by the effusion, the air confined in the vesicles giving a tympanitic note similar to that found in emphysema.

All such cases of doubt in the *diagnosis* of pneumothorax can be solved by the application of the next test—viz. auscultation. On placing the stethoscope over the chest, it is at once noted that the breath-sounds are inaudible, or extremely distant. In some cases, however, where the distension is very great, the breath-sounds from the opposite side may be heard, carried along the tight walls of the cavity. Such cases may be distinguished by another

test—viz. inspection of the chest (vide *infra*). On shaking the patient or changing his position (succussion test), a noise is frequently heard like the striking of two small pieces of coin together (metallic tinkling). This is due to the falling of a drop of fluid from one part of the cavity to the other, or the bursting of a bubble of air, the sound being exaggerated by the drum-like distension of the walls. It is occasionally produced in a cavity *within* the lung-tissue, as in a large tubercular cavity, but never so distinctly as in a pneumothorax: such cases are also readily distinguished by the absence of the drum-like resonance on percussion over any considerable area.

In cases of extreme distension, inspection of the chest may afford valuable information. The walls will be found bulged, the intercostal spaces projecting, and the affected side scarcely moving at all in the act of respiration. This test is especially valuable, as indicated above, where the distension is so extreme as to cause the breath-sounds of the healthy lung to be heard over the affected side. But all degrees of distension exist, and, even in the slighter cases, there is a very marked difference in the mobility of the affected side as compared with the sound one.

Treatment.—From whatever cause arising, pneumothorax, if it does not induce symptoms of considerable distress to the patient, had best be left alone. If it be due to a temporary cause, such as wound of the lung from a fractured rib, the air will probably be absorbed, and the lung will have a good chance of again expanding. Even in some of the medical cases, where it takes place from the perforation of a tubercular cavity, the partial collapse of the lung resulting from it, if it does not have a quickly fatal issue from disturbance of the respiratory area, occasionally results in good to the patient, from checking the progress of the tubercular ulceration, by allowing the parts concerned much more complete rest after collapse than was possible before. It is only in cases where pneumothorax causes great distress to the patient, or where death is impending from pressure upon the lung, that operative measures should be adopted for its relief. These should consist in puncture of the cavity containing the air with a fine trocar and canula, allowing the air to escape freely till equilibrium is re-established. The small canula should then be withdrawn. Immediate relief will be obtained in this way, and the operation may be repeated as often as necessary. This is better than leaving the canula or a

drainage-tube in the wound, unless there is much fluid mixed up with the air, when the drainage-tube becomes desirable for the sake of allowing its escape, and partly also for the sake of washing out the cavity—especially if the contents are fetid.

The *prognosis* of every case of pneumothorax is grave. Very speedy death often takes place in the cases where it results from tubercular ulceration, but, if the patient survives two or three days, life may be prolonged for weeks or months, death finally resulting from a spread of the tubercular disease. The cases in which the prognosis is most favourable, are those in which pneumothorax is due to a fractured rib. The first shock of the injury having passed away, the air generally absorbs and the patient does well. H. G. HOWSE.

POISONED WOUNDS.—The expression 'poisoned wound' is here employed to denote the condition of a wound secondarily infected by a parasitic or other virus, but the term does not include such cases as insect and snake stings or bites, or the special lesions produced by various mineral poisons, though these may be alluded to. In fact, whenever a wound is followed by acute inflammatory mischief spreading from it as a centre, such mischief not being caused by one or other of the rarer animal or mineral poisons mentioned above, it would come under the present heading. It very rarely happens, however, that a patient is attacked by one variety of septic disease at a time, so that it is impossible to define the above expression more closely; and besides, the decomposition-products of one poison, being poisonous in themselves, will give rise by their own action on the system and tissues to an additional train of symptoms. On account of all this complication surrounding the causation of poisoned wounds, the diseased conditions will be simply described according to the ordinary anatomical arrangement of the tissues they attack.

Etiology and Theory of Causation.—It will be best to allude briefly to that theory of the action of the poison, in these cases, which finds most favour at the present day, before discussing the conditions which predispose a patient to suffer from a poisoned wound. Since it is found that, in every case, the wound is contaminated with some filth or other, whether it be fluids from a corpse recently dead, dirt, or any decomposing albuminous matter, it is now assumed, by most writers, that the poison is either one of the chemical products

of decomposition or an actively growing pathogenic and parasitic organism. For discussion of the mode in which these poisons, chemical and living, are supposed to act, reference must be made to SEPSIN; SAPRÆMIA; SEPTIC DISEASES; in which the theories of septic poisons are given at length; but we may repeat here that of the two above-mentioned poisons, the simple chemical product of decomposition, sepsin, while giving rise to local changes about to be described, rarely produces general symptoms of 'constitutional disturbance' unless it is absorbed in quantity. See SAPRÆMIA. On the other hand, a living, rapidly growing virus may easily be understood to multiply and spread through the meshes of connective tissue and along the channels of lymphatic vessels, although only a very small quantity may have lodged in the wound. The bearing of this general outline of the causation in each variety of wound-poisoning will be amplified in describing the different forms of the affection, as they are met with clinically. It only remains, therefore, to consider here the general question of predisposition in the individual which renders him open to attack.

If the above theories of local and of spreading poisons are true, then it is obvious that if a person be overworked, and his tissues anæmic and degenerate from insufficient oxidation, as is so constantly observed in town-dwellers, &c., he will form a good nidus for the development of such a virus. Travers, however, showed long ago that this simple idea of predisposition was clearly insufficient to account for the remarkable escapes of many people, who were exposed to the same mischief as others who unfortunately fell victims. The theory of personal immunity has been put forward lately to explain these facts, and is strongly supported by the powerful authority of Sir James Paget; but, beyond drawing attention here to the possibility of some instances of immunity being due to a process analogous to that of acclimatisation—since such persons are usually constantly working in a poisonous atmosphere or handling poisonous fluids—it cannot be further dwelt on here, and will be found fully discussed in the article on SEPTIC DISEASES.

A word, however, must here be said on the kind of wound which is most frequently followed by septic poisoning, and on the various ways in which the poison is inoculated. As is well known, punctured wounds are the most dangerous; the simple

reason being that the elastic skin closes the aperture of the puncture, and prevents the poison being washed out by the natural out slight flow of blood. The poison may be inoculated in one of three ways—by entry into the cell-spaces in the connective tissue, or by direct entry into wounded lymphatics, or possibly into veins. If it is free in the cavity of the wound, it may be absorbed into the lymphatics by the ordinary current into the lymph-channels, or possibly it may be conveyed by leucocytes. If there is tension in the wound, owing to plugging of the orifice with dry discharge or applications, then of course the chance of further absorption is greatly increased. In considering the question of inoculation and absorption too, it will not be forgotten that, as the surfaces of the wound glaze in a few hours, all channels of absorption—e.g. cell-spaces, lymphatics, &c.—are closed in thirty or forty hours by clotted fibrinous exudation; and, unless inflammation has been set up, they will remain impervious to any further absorption of the poison. The valuable effect of disinfectants, referred to at the end of this article, is due to their exciting this closure of the possible channels of entry.

Pathology and Pathological Anatomy.—The former of these subjects has necessarily been alluded to in discussing the causation of these affections, and, as for the condition, it will be best to describe the anatomical changes under each variety.

Varieties and Symptomatology.—The various kinds of septic mischief which may attack wounds, especially those received in post-mortem examinations and dissecting, are perhaps best grouped as follows:—

1. Simple local inflammation of wound.
2. Inflammation of connective tissues.
3. Pustules.
4. Warts and boils—acute and chronic.
5. Inflammation of lymphatics (superficial and deep), and glands—mild and violent.
6. Inflammation of sheaths of tendons (local abscess), and of fasciæ.
7. Periphrlebitis.

1. *Simple Inflammation of a Wound.*—A wound inflicted by a dirty instrument, a stone, piece of coal, &c., frequently festers and inflames. Instead of uniting in a few days, the edges swell, redden, become everted, and discharge a greyish low, sanious pus, which will be found brimming with putrefactive organisms. The inflammation of the wound here is due to the irritation set up by the decomposition of the discharge, and if this is con-

trolled by the use of disinfectants, hot boracic fomentations, &c., the wound soon heals by granulation. See WOUNDS, Treatment of.

2. *Cellulitis around Poisoned Wound.*—The connective tissues in the neighbourhood of a poisoned wound, especially in the forearms and legs, are very liable to become the seat of an acute, rapidly spreading cellulitis. Roughly speaking, this may be divided under three headings, according to the virulence of the poison on the one hand and, perhaps, the resisting powers of the patient on the other. These headings are, briefly, serous, phlegmonous, and gangrenous (see CELLULITIS), the tissues being infiltrated in the first-named variety with a turbid serous fluid, in the second with pus, while in the third class they are sloughy and discharge a foul sanious fluid, which is purulent in the neighbourhood of the sloughs but (like the other two varieties) serous at the spreading border of the inflammation.

Serous septic cellulitis closely resembles Erysipelas in some particulars—e.g. the spreading border, &c., but the following points serve to differentiate the two diseases. Erysipelas begins as an acute specific disease—viz. with an incubation period (twenty-four hours), feeling of malaise, &c., vomiting, rigors, and high temperature. Septic cellulitis steadily (or rapidly, according to the virulence of the poison, &c.) spreads from the wound, as soon as the poison has been inoculated on it. The margin of the inflammation is well-marked in erysipelas, very diffuse in septic cellulitis, and the general constitutional disturbance in the latter (i.e. pyrexia, &c.) is in its course different from that of erysipelas.

3. *Pustules.*—(a) *Acute Form.*—There are apparently two conditions under which a person may be affected with pustules, as a result of inoculation with some septic poison. Thus, the pustules may be solitary or very few in number, and simply situated on the hands, or they may be multiple and scattered over the surface of the body, as well as those parts which are exposed to direct contamination. The solitary pustule is, sometimes, the result of inoculation in a small crack at the side or on the dorsum of a finger, while, at others, it clearly follows the introduction of the poison into a hair-follicle or sebaceous gland. Consequently, the dorsum of the proximal phalanx is a frequent seat of such pustulation.

The acute form of pustule runs a fairly definite course. A few hours after exposure

to the poison (such, for instance, as putting the unprotected hand into some septic serous exudation, &c.), an infected spot will be felt to itch, the itching stage lasting three or four hours; the part then begins to ache, but before pain is felt it will be found to be reddened. In twelve to twenty hours it swells, and movement of the finger becomes very painful. In thirty to forty hours the centre of the pimple suppurates and forms the typical pustule. If the pustule at this stage is incised and treated with hot antiseptic applications, it may rapidly heal. If neglected, however, there will ensue a slow spreading inflammation of its base, so that the floor of the minute abscess-cavity is formed by a mass of phlegmonously inflamed subcutaneous tissue. Under these circumstances the pustule becomes chronic.

(b) *Chronic Form*.—In the chronic form, the opening of the pustule is liable to scab over, and, consequently, the exudation from the inflamed base collects again in the cavity and causes pain, &c. It may remain in this state, alternately discharging and closing, for three or four weeks, and ultimately heals by absorption of the inflammatory exudation and by cicatrisation.

Treatment.—(a) Prophylactic. Infection, which produces the pustular form of the disease, can practically always be prevented by covering the skin thickly with carbolic vaseline, which must be well rubbed into the hair-follicles, &c. No greasy material answers so well as vaseline, others, like carbolic oil, &c., being easily rubbed off.

(b) Direct. As soon as the first appearance of inoculation is detected, hot antiseptic fomentations should be applied, and the pustule incised when suppuration has begun. Frequently, if the pustule becomes chronic, it may be made to heal speedily by touching the floor of the small cavity with nitrate of silver.

4. a. *Warts*.—The so-called post-mortem room wart, or—to use the term suggested by Dr. Wilks—‘*verruca necrogenica*,’ is a curious condition of the dermis, which often is a relic of a pustule as just described, but sometimes begins, more or less insidiously, from the poisoning of a crack in the skin. When it begins as a pustule, it is practically an extension of the indurated base of that lesion. The induration spreads to neighbouring parts, especially over the knuckles; the epithelium, thickening here and there, forms warty ridges, the furrows between often appearing red and sometimes exuding a little serous fluid. If the warty epithelium is picked off, the papillæ beneath

often bleed a little. In the process of healing, the cracks, &c., gradually dry up and heal, the thickened epithelium scaling off. This condition, though usually attributed to the direct effect of putrid substances, may, perhaps, in some instances be started by some of the powerful metallic salts used as disinfectants, and a predisposition produced in the tissues by the free handling of freezing mixtures (e.g. ice and salt, &c.), used in the preservation of tissues, &c. It is an exceedingly obstinate affection and very often remains unchanged for several years, or alternately heals up and breaks out again.

Treatment.—(a) Prophylactic: see *Pustule* above. (b) Direct. The best immediate treatment is to keep the part constantly covered with some antiseptic but not very irritating ointment (e.g. boracic vaseline, &c.). If the epithelial thickenings are considerable, they often can only be reduced by the continuous application of wet boracic lint.

4. b. *Boils*.—Between the strictly local affections, just described, and the general infection of the lymphatic system, about to be mentioned, there is a class of partly local, partly general, inflammatory lesions which are boils, although their mode of origin is often peculiar. Practically the condition amounts to this, that a pustule is found in the ordinary way above described that this pustule soon becomes (by formation of a central slough or core) a boil of considerable size, and is then followed at various intervals of time (often a week or more) by others cropping out in different places on the affected limb; or they may also appear on the opposite side, probably by direct inoculation rather than generalisation of the poison. These boils customarily become fully developed in a few days (three to four), and when they are incised or spontaneously burst, there is found to be a central core or slough, bathed in pus, surrounded by the connective tissues in a state of phlegmon. If incised before they burst, although tension is thereby got rid of and pain greatly relieved, the central slough still forms as a rule. After separation of the core the cavity heals by granulation. These boils, varying in size, painfulness, &c., may continue to crop out at intervals for several weeks, or even a month or two, sometimes appearing to follow the course of the superficial lymphatics. With the formation of each boil there occur symptoms of general constitutional disturbance—headache, sickness, anorexia, pyrexia—temperature rising to 101°–102°; these symptoms

toms, however, being considerably mitigated towards the end of the attack.

Treatment.—*Prophylactic*, as above directed. *Direct.* The best applications to these boils are hot antiseptic fomentations, while at the same time free incision should be made into the centre of the boil and discharge encouraged. General treatment is of equal importance, and the patient should be given 15 to 30 grains of quinine a day and sent into bracing country air.

5. *Acute Lymphangitis and Lymphadenitis* arising from poisoned wounds, and especially wounds received in dissecting, &c., have been aptly described as divisible clinically into two forms—viz. mild and violent. Practically, this depends on whether the superficial or deep lymphatics respectively are involved; when the former, the affection being comparatively a slight one, but if the latter, a very grave one. In either case, the poison may be absorbed directly into the lymph-stream by means of a slight wound, or more rarely through the (apparently) unbroken skin. It is noteworthy, in considering the mode of inoculation, that this condition is almost always consequent on a very slight wound, and one therefore which, not attracting attention at the time of inoculation, is not treated until too late to prevent the spread of the poison from the point inoculated.

a. *Superficial Lymphangitis and Lymphadenitis.*—*Symptomatology.*—The point inoculated becomes reddened, swollen, and painful in a few hours after inoculation, the pain shooting up the limb from the wound. In twelve to twenty-four hours, the track of absorption of the poison along a main lymph-vessel is shown by a red line or lines, extending from the hand up the forearm to the lymph-gland just above the elbow, and from thence to the axillary glands, which rapidly swell. The pain and line of absorption appear to be as often on the radial and posterior surface of the limb as on the anterior and ulnar, and patients frequently complain of pain along the course of the musculo-spiral nerve, even after active mischief has subsided.

In consequence of the lymphangitis, the whole limb becomes swollen and cedematous. It feels heavy and tense to the patient, who is intolerant of the least pressure on it. At the same time the inflammation of the glands progresses, and by the third day they are greatly swollen and excessively tender; the least movement of the limb, dragging on the fasciæ covering them, causes great pain. General 'constitutional' disturbance, produced either by the direct

absorption of the inflammatory products or indirectly through the irritation of the peripheral nerves, is evidenced by delirium, exhaustion, and rise of temperature to 103° F. or higher, loss of appetite, &c. This condition very rarely terminates fatally where active treatment has been adopted, and the symptoms just described gradually abate.

Treatment.—In the first instance, care must be taken that there is no tension in the original puncture or wound, which should be laid freely open, if necessary, and treated with hot antiseptic fomentations changed frequently (every hour or two), the limb being slung upon Volkmann's suspension splint, or supported on pillows so as to be higher than the patient's body, as he lies in bed. If the patient can bear the more or less necessarily dependent position of the limb, it may be slung in an arm-bath for half an hour or an hour once or twice a day, especially if it has been found necessary to make free incisions. The inflamed glands should be painted over thickly with extract of belladonna and glycerine, and then hot flannel fomentations frequently applied. Of course, as soon as fluctuation with extreme throbbing pain develops in any gland, it must be incised with antiseptic precautions. Relapse of the lymphadenitis is sometimes noticed in these cases, and, consequently, suppuration may be delayed to the end of the first fortnight or even later. The general symptoms are best met by giving quinine in the acute stage, and adding iron as soon as the appetite has fairly returned.

b. *Deep Lymphangitis and Lymphadenitis.*—The affection of the deep lymphatic structures is fortunately relatively very rare, especially at the present time, when the use of powerful disinfectant reagents is beginning to be understood.

Symptomatology.—The condition of inflammation of the deep lymphatics is very rarely accompanied by superficial lymphadenitis, so that it not infrequently happens that the first symptom complained of is pain in the axilla; and this may be diffused and described as being 'in the shoulder,' or referred at once to the lymph-glands. The wound, the seat of inoculation, is usually so small a puncture as not to have been noticed. This was the case in six out of seven cases described by Travers, taken at random. So far as can be made out, there is in these cases a distinct 'incubation period,' averaging forty-eight hours in duration but often less, during which time the patient may feel tired but not ill. Thus it happens that general symptoms begin rather suddenly, at the time when the local

mischievous first attracts attention. About two days or less after inoculation the patient feels extremely ill, frequently has a shivering fit or severe rigor, this being followed by vomiting and a rapid rise in temperature. When the pain in the armpit or shoulder has made itself felt for a few hours, there will be found fulness of the axilla, often reaching up into the posterior triangle and down along the inner side of the arm to the elbow. The swollen area becomes exquisitely tender, and the whole limb tense and insupportably heavy. The inflammation of the connective tissues rapidly increases in the next few days, so that the cedematous fulness extends downwards over the latissimus dorsi, sometimes as far as the buttocks, upwards and backwards over the trapezii, and forwards over and beneath the pectoralis major. Owing, no doubt, to the confinement of the areolar planes between the pectoral muscles, it is here that the tension becomes most severe, and, consequently, pectoral abscess is so common a feature of this condition. The skin over the whole tender area soon becomes intensely congested, and, unless the deep mischief is arrested, it becomes dusky, and vesicles containing a little turbid fluid form on the surface. In fact, there is a very acute serous cellulitis starting from the neighbourhood of the infected lymph-glands, and becoming gangrenous if not interfered with.

The general symptoms, mentioned above, increase rapidly with the development of the local trouble. The most noteworthy point among them is the intense depression of the nervous system, so long as the patient is conscious; delirium is usually present towards evening, and, in fatal cases, death is preceded by coma for twenty-four hours or more. The pulse and respirations vary, of course, in number and quality according to the intensity of the general symptoms, which amount to those of acute SEPTICÆMIA. In a prolonged case pleurisy of the affected side may be present, and sometimes this becomes empyema. Pneumonia is a rarer complication.

Treatment, &c.—The parts which require frequent and careful examination are the borders of the pectoralis and trapezius muscles, as suppuration tends to burrow towards those points. If there are localised spots of very intense pain on deep pressure, incision should be made through the skin, and pus searched for with a director or aspirator needle, the abscess, when present, being freely opened antiseptically. Since free incision liberates the sero-purulent fluid of the cellulitis, as well as the pus and

sloughs of the abscess, it is clear that an early incision can do no harm, if performed antiseptically. As a rule, external applications, such as leeches, fomentations, &c., give little relief, but the latter should not be omitted. Early incision is the principal line of treatment, coupled with large doses of quinine, and salicylate of soda, ten to fifteen grains every four hours, with careful supervision. The latter drug is best given by injection into the rectum in an ounce of milk. Special attention should be paid to the diet, and a proper amount of stimulation by alcohol, ammonia, ether, &c., if the pulse fails. As soon as possible the patient should be removed to country air, early change always being followed by a more favourable condition. In a case where the cellulitis is gangrenous, an attempt should be made to arrest it by hypodermic and interstitial injections, into the border, of hydrarg. perchlor. 1 in 1,000, or of carbolic acid. See HYPODERMIC INJECTION. Complications, such as pleurisy, &c., must be treated on general rules, early aspiration being advisable.

Prognosis.—The termination of such a case will depend, first, on the virulence of the poison, a factor which only reveals itself by the relative violence of the early symptoms. Another factor of extreme importance is the particular susceptibility, or the reverse, which the patient may show towards septic poisons, and, lastly, the state of the patient's general health. If suppuration is detected early and freely liberated the prognosis will be improved. Any sign of duskiness or vesication, indicating that the cellulitis is likely to be gangrenous, is of course extremely unfavourable.

6. *Inflammation of the Sheaths of Tendons (Thecal Abscess) and of Fasciæ.*—A not uncommon consequence of septic puncture of the digits is inflammation of the sheaths of the flexor tendons, but as this presents no special features beyond rapidity of development according to the septicity of the poison, reference must be made to WHITLOW.

Inflammation of the fasciæ and intermuscular septa is, like inflammation of the sheaths of tendons, merely another variety of cellulitis following infective lymphangitis. For the above-named structures possess a very rich network of lymphatics and capillary spaces, being, in fact, great areas for the collection of the lymph. In cases of inflammation of fasciæ, &c., the condition is simply that of cellulitis affecting all the connective tissue structures in the limb, which consequently swells very much, and, on free incision being made, the whole of its loc-

issues are found to be infiltrated with serous. See CELLULITIS.

7. *Periphlebitis*.—This is a very rare consequence of a poisoned wound, but sometimes occurs, and therefore is noted here. See PHLEBITIS.

Summary of Treatment.—The subject of 'poisoned wounds' has been so elucidated during the last few years by the labours of Koch and others, that the lines of general treatment are rendered as easy now as they were difficult when Travers wrote his celebrated treatise on the question. If a person is conscious of having wounded himself under circumstances in which he is likely to become poisoned, he should at once encourage bleeding from the part by constricting the limb or digit on the proximal side of the wound. He should then wash the wound very freely with hot water, and, if it is a punctured one, he should suck

If the poisonous matter is from the body of a person who has died very recently of a highly infectious disorder, such as pueral fever, pyæmia, &c., and the wound be a deep puncture, it would be wise to convert the puncture into a small incision and then apply some disinfectant as follows. After the wound is thoroughly washed as above described, it will be sufficient in most cases to irrigate it thoroughly with 1 in 20 (one per cent.) solution of carbolic acid, and then to dress it with hot boracic lint. If the poison is probably very virulent, a drop of pure carbolic acid should be placed in the wound; but free cauterisation with caustics is to be avoided, as only depressing the vitality of the tissues of the wound. The subsequent treatment of each variety has already been described, and need not be repeated here; but attention may be directed to the fact that it is quite an exception for any variety to be uncomplicated, and that the lines of treatment, indicated above, must be greatly varied to meet the individual peculiarities of each case, care being taken—(a) that the poison be destroyed locally as far as possible; (b) that its absorption by the lymph-stream, &c., be prevented or actively treated if already in progress; and (c) that the patient be treated generally as if suffering from acute PYÆMIA. Prophylaxis has already been referred to under the sub-heading of *Pustules*.

VICTOR HORSLEY.

POLYMAZIA or SUPERNUMERARY BREASTS.—This condition is far more common than absence of the gland. It divides it into three forms—1, supernumerary breasts in the pectoral region; 2,

in or near the axilla; and 3, in distant parts of the body. In the pectoral form as many as five breasts have been observed. The separate glands in these cases are each provided with a nipple, and secrete milk during pregnancy. Two varieties of axillary breast have been described: one entirely distinct and provided with a nipple, and one consisting merely of a separated portion of the normal gland. The second variety is only recognised by its swelling during lactation. Possibly, such outlying portions of mammary tissue may be the true seat of origin of those cases of cancer which apparently commence between the gland and the axilla. Supernumerary breasts in distant parts of the body have been observed in the groin, on the back, on the outer side of the thigh, and elsewhere. In some cases the child has been suckled from these abnormal glands.

MARCUS BECK.

POLYPI.—A polypus may be described as a more or less definitely pedunculated or sessile abnormal projection from a mucous membrane. The precise position of polypi as regards classification is still a matter on which opinions differ; probably truth rests with each side, for many polypi are local hyperplasias in the restricted sense, while others may be regarded as true tumours.

Origin.—The mode of origin of certain polypi, especially those of the stomach and intestines, clearly indicates that they are local hyperplasias.

In the stomach, a mammillated or villous condition, culminating in polypoid growths, is seen as the result of long-continued chronic gastritis, which, by inducing hyperplasia of the submucous connective tissue, is presumably the primary cause of the polypi. Again, in the intestines abundant small polypi are commonly found above strictures; they are usually arranged in parallel transverse lines, and are evidently due to exaggeration of the normal transverse folds of the mucous membrane, parts of which become more prominent, and finally pedunculated. Nasal polypi are frequently associated with a general thickening of the lining membrane of the turbinated bones. On the other hand, in the glandular polypus, which reaches its most typical development in the lower part of the large intestine of children, the new formation of gland-tissue so greatly preponderates over the other constituents that such growths cannot be separated from the adenomata; and can no more be considered local hyperplasias than the glandular proliferous

growths of cystic tumours of the breast and ovary.

Structure.—Polypi are either solid or may be almost entirely composed of cysts; but many chiefly solid polypi contain gland-tissue which, by dilatation of its tubules, gives rise to cysts often only visible with the microscope; and in the mucous polypi cyst-formation results from mucoid degeneration of the connective tissue.

Compound cystic polypi are met with in the cervical canal of the uterus, where, from dilatation and projection of the mucous follicles or glandulæ Nabothi, sessile vesicular masses are formed, which may protrude through the os. Distension of the glandular follicles of the stomach and of the antrum of Highmore also gives rise to polypi composed of a single vesicle.

Minute Structure.—As regards their minute structure, polypi, for purposes of description, may be divided into mucous or myxomatous, fibrous and sarcomatous, fibro-muscular and glandular.

MUCOUS POLYPI.—These form the largest and most widely distributed group, being found in the nose, ear, intestines, bladder, and uterus. *See NASAL POLYPUS.*

Mucous polypi are soft in consistence, succulent, gelatinous, and semi-transparent on section. On squeezing the cut surface small masses of mucus appear, which on removal leave small cyst-like cavities. The polypi are covered with a layer of epithelium of the same form as that of the mucous membrane from which they spring; for example, the mucous polypi of the nose are invested by a double layer of columnar ciliated epithelium. But if the polypi protrude from an external orifice, as may occur in those occupying the nose, rectum, or uterus, the epithelium covering the protruded portion is transformed into the squamous variety. A section of a mucous polypus shows, under the microscope, an interlacement of delicate fibrils, with round, elongated and stellate cells interspersed, the protoplasm of the cells being directly continuous, by means of delicate prolongations, with the fibrils of the stroma. Delicate bands of fibrous tissue traverse the section, and the capillaries are abundant and embryonic. If mucous degeneration is far advanced, the meshes of the stroma are wide, with large gaps formed apparently by solution of the connective-tissue substance. The proportion of cellular elements present in the stroma varies in different specimens and in parts of the same; the round cells may be so abundant as to obscure the fibrillar stroma.

A few gland-tubules can generally be found in the mucous polypi of the nose; in one specimen the writer observed very numerous small, irregularly-massed tortuous tubules lined with very small elongated cells, of which the appearance, together with the characters and arrangement of the tubules, left little doubt that the gland-tissue was newly formed. All mucous-like polypi are not true myxomata, some of those of the intestine being composed of loose fibrous or connective tissue; while many of the so-called polypi of the ear are composed of granulation-tissue.

FIBROUS AND SARCOMATOUS POLYPI.—They occur in the posterior and upper part of the nares and in the pharynx, where they spring from the basi-sphenoid, being intimately connected with the periosteum of that bone, which they sometimes perforate. Some of them are composed simply of fibrous tissue, but, in the opinion of the writer, the majority, and especially those of the naso-pharynx, contain so large a proportion of cellular elements as to ally them with the sarcomata. Their structure is best expressed by the term fibro-sarcoma, the connective tissue being ill-formed, or even homogeneous, and containing more or less abundant round and elongated cells and nuclei, in various stages of transition towards the formation of connective tissue. Ossification may take place in them to a considerable extent. A single pedunculated polypus composed entirely of spindle cells has been observed in the nose. *See NASO-PHARYNGEAL GROWTHS.*

The tendency to hæmorrhage in these polypi may be explained, probably, by the presence of numerous blood-vessels of moderate size, having no proper wall except the furnished by a layer of endothelium, and showing at intervals irregular dilatations.

FIBRO-MYOMATOUS POLYPI.—They commonly occur in the uterus, and, rarely, in the bladder in cases of enlargement of the prostate gland. Their minute structure need not be described here.

ADENOMATOUS POLYPI.—Among these are included polypi largely composed of gland-tissue, such as those situated on the lower part of the large intestine of children. The gland-tissue consists of straight or convoluted tubules lined with long columnar epithelial cells, many of which are distended with mucus or are 'goblet-shaped'. Some of the tubules open on the free surface of the polypus; others are dilated to various degrees. The stroma is scanty and composed of fibrillar connective tissue enclosing round cells, which are most abun-

ant around the tubules. The writer has examined polypi of the uterus containing large proportion of gland-tissue, with aroma of fibrous tissue or of spindle cells.

PAPILLARY POLYPI.—Ranvier describes specimen of nasal polypus, of which the surface was covered with composite papillæ, invested with a thick layer of squamous epithelium.

FREDERIC S. EVE.

POMPHOLYX. See PEMPHIGUS.

POPLITEAL ANEURISM. — 1. *Causes.*—For the general causes see ANEURISM. The following facts probably explain the great relative frequency of aneurism in connection with the popliteal artery:—*a.* Arteries are particularly prone to become the seat of atheroma where they lie in contact with bone, and hence the popliteal artery is very frequently atheromatous, and liable to become aneurismal. *b.* The popliteal trunk is the only part of the main artery of the lower limb that is not well supported by the surrounding tissues. The entire length of the femoral artery is supported by muscles or firm fascia, while in the middle of the ham the vessel is surrounded on the back and sides by soft compressible cellular tissue and fat. *c.* During the free and rapid movements of the knee, the constant changes in the length and calibre of the vessels may predispose to the formation of aneurismal pouchings. *d.* Immediately below the ham the artery breaks up into smaller vessels, lying deeply under muscles by which they are supported or compressed; this may occasion such resistance to the passage of blood into the leg as to favour the swelling of the popliteal vessel just above.

The share which embolism takes in the production of aneurism is not fully determined, but it is obvious that an embolon, entering the main artery of the lower limb, is particularly liable to be arrested at the bifurcation of the popliteal artery, and this mode of origin may account for some cases of aneurism in this situation.

2. *Pathology.*—All varieties of aneurism, except the 'dissecting,' may be met with in the ham; but the various forms of 'traumatic aneurism' are very rare. Fusiform aneurism may be found as a globular dilatation of the whole circumference of the artery, or as a spindle-shaped dilatation of some length of the vessel. A sacculated aneurism may spring from the anterior or the posterior aspect of the artery, and upon this difference depend, in no small degree, the subsequent progress and complications of the cases. Aneurisms springing

from the front of the artery are usually of small size, and are liable to cause caries of the femur or tibia, with destruction of the posterior ligament of the knee-joint, and they may rupture into the joint. Aneurisms springing from the back of the artery grow fast, and reach a large size, owing to the slight resistance offered to their enlargement by the yielding tissues of the ham; they often interfere seriously with the return of blood through the popliteal vein—compressing or even destroying that vessel—and cause severe pain from pressure upon the internal popliteal nerve; they are very prone to become diffused, bursting either subcutaneously or beneath the popliteal fascia. When subcutaneous rupture occurs, the blood rapidly infiltrates the superficial cellular tissue, and the deeper planes as well; when the rupture is sub-fascial, the infiltration of the blood may be more gradual, or quite sudden, spreading up the back of the thigh and down beneath the calf of the leg; if extensive, it quickly impedes the venous circulation, and leads to moist gangrene of the foot and leg. Double popliteal aneurism has been frequently observed, and there are many recorded cases in which the cure of one aneurism has been quickly followed by the development of another in the opposite ham. For the general pathology of popliteal aneurism, see ANEURISM.

3. *Symptoms and Diagnosis.*—The earliest symptom of popliteal aneurism is usually pain in the knee, with a certain amount of stiffness of the joint, which is kept flexed, and hence the patient is very apt to regard his affection as 'rheumatic.' These symptoms may increase, the pain becoming constant and severe, and the movements of the joint more limited. To them may be added pain down the calf of the leg and in the sole of the foot, from pressure upon the internal popliteal nerve; and lividity and œdema of the leg and foot, from pressure upon the internal popliteal vein; while the patient may be conscious of a 'sensation of beating' in the ham. Occasionally the patient can fix precisely the time of origin of the aneurism, on account of the sudden occurrence of pain and stiffness; in other cases the symptoms come on more insidiously. On examining the ham, the surgeon will detect a tumour over, and fixed to, the artery, with an expansile pulsation in every part, and possibly also a thrill accompanying every upheaval of the tumour. On compressing the femoral artery in the groin, not only is the pulsation arrested, but the swelling collapses or yields

under compression to a greater or lesser extent, and then, when the finger is removed from the artery, the pulsation immediately returns with full force in the tumour, which assumes its former size in two or three bounding beats. Auscultation over the tumour reveals a blowing, systolic murmur, which at times may be replaced by a musical or a rasping bruit, and there may be, in addition, a diastolic sound. On comparing the pulse in the tibial arteries of the two sides, that on the side of the tumour will be found delayed behind the other, smaller and weaker. There may be considerable œdema and venous congestion below the ham; frequently there is a certain amount of fluid in the knee-joint, filling out the synovial pouches, and causing 'floating of the patella.' There may or may not be evidence of atheroma in the brachial, temporal, and other superficial arteries, and of hypertrophy of the left ventricle of the heart.

An aneurism being recognised by these signs, the surgeon should proceed further with his investigations, for the purpose of determining its relation to the popliteal artery, the condition of the sac and its contents, and the degree to which the surrounding structures are involved in the tumour. If the tumour be large, of rapid growth, and threatening to become 'diffused,' venous obstruction and pain along the branches of the internal popliteal nerve having been early and marked symptoms, the aneurism is connected with the back of the artery. If, however, the tumour be of small size and slower growth, but attended with constant and severe pain in the knee, while the signs of pressure upon the popliteal vein or nerve are slight or altogether absent; and especially if the pulsation be markedly thrilling, or a distinct line of pulsation, corresponding to the artery, can be felt over the tumour, it is an aneurism springing from the front of the artery. It is this variety of aneurism that is frequently accompanied with synovitis of the knee-joint. If the tumour be clearly defined, firm, with deep pulsation, and but very slightly compressible when the flow through the artery is arrested, it shows that the sac is filled to a large extent with clot; while if the tumour be ill-defined, soft, perhaps fluctuating, with very superficial pulsation, and the tumour can be completely emptied by gentle pressure, when the arterial flow is arrested, it indicates that the contents of the sac are all fluid blood. All intermediate grades between these two extremes are met with.

When an aneurism is noticed to enlarge rapidly, but at the same time its outline

becomes less well-defined, the pulsation indistinct, and the bruit altered in character, the signs point to a giving way of the sac, and a slow leaking of the blood into the surrounding tissues; this may occur beneath the strong popliteal fascia, and, from the pressure of the effused blood upon the vein and nerves, there will be considerable œdema of the leg and foot, and severe pain and numbness. When a patient with an aneurism experiences a sudden sharp pain in the ham, as if he had been struck, followed by a hot trickling sensation in the leg, and general pallor and faintness, while the surgeon finds a sudden and great increase of the swelling, with entire loss of its outline, loss of pulsation and thrill, and great diminution in the intensity of bruit; and if with this there be ecchymosis of the skin, intense œdema, coldness, lividity, and numbness in the leg below, while there is no pulse in either of the tibial arteries, it will readily be recognised that the aneurism has burst subcutaneously, with free extravasation of the blood and complete arrest of the circulation in the limb below.

An aneurism growing from the front of the artery may burst into the knee-joint. This event would be recognised by the sudden distension of the cavity of the joint and the formation of a tense pulsating swelling, which may yield under the hand when the femoral artery is compressed. The introduction of a fine trocar or a grooved needle would, in a case of doubt, show the nature of the fluid. The comparative fulness of the pulse in the tibial arteries shows the extent to which the aneurism interferes with the arterial circulation; the amount of venous distension and œdema in the leg and foot is a measure of the obstruction to the venous return. Even aneurisms of small size may seriously compress the popliteal vein, and ultimately lead to its obliteration. This is a very important point to determine, as, where there is great obstruction to the venous return, any treatment of the aneurism, if attended with occlusion of the artery—and from this possibility no form of treatment is exempt—is very liable to be followed by gangrene. The extent to which the popliteal nerve is compressed by, or involved in the sac of, the aneurism, can be determined by the severity of the pain referred to the leg and foot, by numbness and paralysis. Destruction of the ligament of Winslow and caries of the bones of the knee are recognised by the ordinary signs of these affections, particularly by the severe local pain and the limitation of movement of the joint.

Should the parts about an aneurism become swollen, cedematous, hot, painful, tender, and reddened—the swelling obscuring the outline of the aneurism, and lessening the distinctness of the pulsation—while the limb below retains its former appearance, and the tibial pulse is not lost, the surgeon must diagnose inflammation around the sac of the aneurism. General fever will aid this diagnosis. Should abscess form, fluctuation will be detected, and if an incision be made, masses of blood-clot or fibrin will be discharged with the pus, and sudden profuse hæmorrhage from the aneurism will probably occur in a few hours or days. One other change in an aneurism requires to be carefully recognised, and that is its cure. If spontaneously, or as the result of treatment, an aneurism becomes firmer, and loses its expansile pulsation, its thrill, and its peculiar bruit, it may be held to be solid, and if this condition persist it is cured. If the artery be not at the same time obliterated, there will still be a heaving pulsation in the swelling, and on gently compressing the swelling against the artery, a thud-like murmur may be heard in it. A cured aneurism gradually shrinks, and if this lessening in size be not observed, it affords ground for serious suspicion that there is still some blood entering the sac from the artery.

4. *Treatment*—Except in the conditions named below, when very prompt action on the part of the surgeon is demanded, he will do well to place his patient in bed on a dry and somewhat restricted diet, and keep him under observation for some few days before deciding upon the course of treatment to be adopted. In addition, a thorough examination of the heart, great vessels, lungs, and other viscera should be made. Where the aneurism is of small or moderate size, and its sac contains a fair amount of laminated fibrin, and the patient is placid and submits patiently to the necessary restraint, some form of *compression* should be employed. If the pulsation in the aneurism be readily stopped by flexing the knee, *flexion* should be tried. For this, the limb should be evenly bandaged with a domett from the toes to the ham, and a lithotomy anklet placed on the foot. With the patient lying on the affected side, the knee should be bent to a degree just sufficient to arrest all pulsation in the sac, and it should be fixed in that position by a bandage from the anklet to a band round the waist, and supported by heavy sand-bags laid along the thigh and leg. If the patient complain of the restraint of this position, a subcu-

taneous injection of morphia, gr. $\frac{1}{4}$, should be given. Every few hours the surgeon should examine the aneurism, to feel whether the sac is solid. This should be done without altering the position of the limb. If the patient bear the treatment well, the position may be maintained for four days after the sac is felt to be solid, and then the limb gradually extended, a careful watch being kept upon the aneurism for any return of pulsation. If the restraint be unbearable, the knee may be partially straightened out as soon as the aneurism is felt to be solid, and compression applied to the femoral artery by a Carte's compressor, a bag of shot fastened on the groin, or by digital compression. If the limb be extended and no compression applied to the artery, the clot formed is very liable to disintegrate and the pulsation to return as before. Should no change occur in the aneurism after a fair trial of flexion for forty-eight hours, it may be abandoned. This treatment is not suited to aneurisms of large size, or to those with thin sacs and rapidly enlarging.

For aneurisms of small or moderate size, in patients who are free from internal aneurism, fatty degeneration of the heart, and very advanced arterial disease, *Esmarch's bandage* may be tried with good hope of success. The patient should be prepared by rest in bed, and a dry albuminous diet for a week or ten days. The bandage should be applied from the root of the toes up to just below the aneurism, while the patient is recumbent; or it may be wound firmly round the upper part of the leg only, and then, while the patient stands up, it should be continued obliquely across the front of the knee, and around the lower half of the thigh above the aneurism. The bandage should be kept in place for an hour and a half, pain being subdued by hypodermic injections of morphia or the administration of chloroform. When the bandage is removed, compression of the femoral artery at the groin must be kept up—if the aneurism be not solidified, for twelve hours; if it be solidified, for forty-eight hours, being gradually lessened after the first eighteen hours.

If these methods have failed, or the case be not deemed suitable for them, *simple compression* of the femoral artery should be employed. This is best done by digital compression at the groin, by relays of assistants, who should work in pairs, one having his hand on the aneurism to notice any pulsation in it, and the other compressing the artery with his thumb

with force just sufficient to obliterate pulsation in the tumour; a conical weight or bag of shot pressing on the thumb will greatly facilitate this procedure. Where assistants cannot be procured, Carte's compressors should be used, one being placed at the groin, and one about the middle of the thigh, and used alternately for half an hour, the second being screwed down on the artery before the pressure of the first is relaxed. The skin of the thigh should be washed with spirit lotion two or three times a day, and then carefully dried and powdered, and the pressure employed should not be more than sufficient to abolish all pulsation in the sac below. So soon as the aneurism is found to be solid, the pressure may be relaxed. Continuous compression cannot be prolonged for more than forty-eight hours, but some surgeons prefer to apply it for eight or ten hours a day, merely having a bag of shot bandaged on to the groin in the interval; unless distinct benefit be obtained in a week, this treatment should be discontinued. Should the aneurism continue to enlarge in spite of compression of the femoral artery, or the patient become very restless and irritable, the treatment must be discontinued.

When these measures fail or cannot be carried out, the femoral artery should be *ligatured* at the apex of Scarpa's triangle. Where the patient is of an irritable disposition, and resents confinement and restriction, or where there is reason to suppose that the sac has ruptured, but without free extravasation of blood, this should be resorted to at once; and now that the operation is so much less dangerous than formerly, a patient should not be harassed and worn out with long and repeated applications of compression before resorting to it. If the ligature be followed by dry gangrene, the dead part should be wrapped in iodoform cotton-wool, and allowed to separate spontaneously, the surgeon merely dividing the bone, or trimming up the stump left. If, however, moist gangrene occur, the surgeon must not wait, but *at once* proceed to amputate the limb just above the condyles of the femur.

When the ligature fails to cure the aneurism, and a pulsating tumour is still left in the ham, the surgeon must first of all determine whether the artery be obliterated at the seat of ligature, and if he find it still pervious there, from premature softening of the ligature, he should reapply the ligature close to the same spot. If, however, the artery be obliterated, digital compression of the femoral artery at the groin should be employed, aided by direct compression of

the tumour itself, or Esmarch's bandage may be tried. Should these measures entirely fail, and the patient be young or middle-aged, and with a healthy heart and arteries, the external iliac artery should be tied; if the patient be old, or with a weak or diseased heart, or advanced arterial disease, it would be better to amputate through the lower third of the thigh. Where an aneurism has ruptured externally, or subcutaneously with free extravasation of blood, amputation should be at once performed close above the tumour. Where the aneurism has caused extensive caries of the knee-joint, amputation is also indicated. Should there be evidence of commencing inflammation around the aneurism, ligature of the artery should be performed at once, and the usual means taken to allay the inflammation; if abscess form, an early incision should be made into it, and if hæmorrhage occur from the aneurism, or the aneurism burst into an abscess, the limb should be amputated just above the knee. If the aneurism rupture into the knee-joint, the femoral artery should be tied; should this fail to cure the aneurism, or the joint remain useless, amputation through the thigh is indicated.

A. PEARCE GOULD.

POPLITEAL ARTERY, The, extends from the opening in the adductor magnus, down the back of the knee to the lower border of the popliteus muscle. It reaches from five inches above, to two inches below the knee, bifurcating at the level of the tubercle of the tibia.

Coverings.—1. Skin thin, but pretty firmly fixed. 2. Superficial fascia with but little fat; in this fascia are the small sciatic nerve and the external saphenous vein. 3. The deep fascia, called popliteal, is dense and firm; the external saphenous vein perforates it. Beneath the fascia are the popliteal space and its contents. This is a diamond-shaped space, bounded above by the diverging hamstrings, below by the converging heads of the gastrocnemius. Most superficially is the internal popliteal nerve; the vein lies on the artery; the artery lies the deepest. The popliteal vein lies slightly to the outer side of the artery; whilst the internal popliteal nerve—which is first one inch external, and then on the artery—finally tends to the inner side. The artery rests on the femur, the posterior ligament of the knee-joint, and the popliteus fascia covering the popliteus muscle.

Ligation of the Artery in the Middle Third.—Lay the patient on the face or in

the three-quarter prone position. Make a perpendicular incision in the line of the vessel, having its central point opposite the knee. The incision should be three inches long at least. Cut through the skin and superficial fascia, avoiding the external saphenous vein; divide the popliteal fascia; clear away the fat with the director; pull outwards the internal popliteal nerve; open the vessel-sheath on its inner side, separate the vein, and pass the needle from without inwards.

Ligation of the Artery in the Upper Third is best done from the inner side of the thigh. Lay the patient on the back; place the limb as for ligation of the femoral; the surgeon is to assume also the same position relative to the limb. Make an incision three inches long just behind a line drawn upwards from the adductor tubercle; the lower end of the incision being on a level with the tubercle. Cut through skin and superficial fascia; avoid the internal saphenous vein and nerve, pulling them backwards; recognise the sartorius, and cut through the fascia along its anterior edge, to find the round tendon of the adductor magnus; clear the part, tying or twisting some branches of the anastomotica magna; pull back the sartorius, the gracilis, the semi-tendinosus and semi-membranosus, and, passing the director behind the adductor tendon, search amongst the fat, when the artery will be easily found. Pass the needle from before backwards, and apply the ligature as far as possible from any of its larger branches.

The popliteal artery can only require to be tied for wounds or rupture, involving possibly the knee-joint, and, under these circumstances, the operation must be more or less of a tentative nature, and be performed under the disadvantages of the popliteal space being filled with blood-clot, and the pulsation of the artery arrested.

JAMES CANTLIE.

POPLITEAL ARTERY, Wounds of the.—1. *Causes.*—Stabs and other wounds inflicted from without; ulceration of the artery by the pressure of a sequestrum of the femur, or by laceration during its extraction. The artery may be ruptured subcutaneously by severe blows, strains, or wrenches.

2. *Signs and Diagnosis.*—If there be an external wound or sinus there is profuse arterial hæmorrhage, the limb below becomes blanched and cold, and the pulse in the tibial arteries is greatly weakened or lost. Loss of tibial pulse indicates a very

free or complete division of the artery; if the tibial pulse be not affected, it shows that the hæmorrhage is from some branch and not from the main trunk. The signs of a subcutaneous rupture resemble those of a ruptured aneurism; there is a rapidly formed tense swelling in the ham, extending up the thigh and down the leg; coldness, pallor, and loss of pulsation in the arteries of the leg, which quickly becomes gangrenous. There may be a bruit in the swelling; signs of inflammation are wanting.

Treatment.—If all hæmorrhage has ceased when the surgeon sees the case, he should content himself with dressing the wound antiseptically, and with keeping the leg and foot slightly raised and at perfect rest, either fixed on a splint or resting between firm pillows. Where hæmorrhage is continuing, a tourniquet should be applied at once, and both ends of the artery sought and tied. For this it may be necessary to enlarge the wound, the incision being made parallel with the vessel, and great care taken not to injure the external saphenous vein and the popliteal vein and nerve; the artery lies very deeply, and the operation may prove exceptionally difficult. If the popliteal nerve is found severed, its ends should be united with fine catgut. If the vein be also wounded, it is a grave question whether amputation should not be at once performed; and if the wound be extensive, with contusion and laceration of the soft parts, or injury to the bone or joint, or the patient be old with a weak heart and diseased vessels, this would certainly be the better course. Should the patient be young and otherwise healthy, and the wound a clean incision and limited in extent, the vein should be ligatured as well as the artery; but if moist gangrene ensue, secondary amputation at the level of the wound will be necessary. In cases of necrosis of the femur, an attempt to tie the artery should be made, but if this be found impossible, amputation of the thigh should be at once performed. Should secondary hæmorrhage occur, an attempt to re-ligature the vessel should be made; failing this, amputation is indicated. In cases of rupture of the artery, an incision should be made along the outer edge of the semi-membranosus muscle, and search made for the ends of the vessel, which should be tied. The effused blood should, as far as possible, be allowed to escape, and the condition of the limb below be carefully watched. If signs of 'moist' gangrene appear in the foot and leg, amputation

through the lower third of the femur should be at once performed; where the gangrene is 'dry,' the separation of the sphacelus may be left to nature.

A. PEARCE GOULD.

POPLITEAL SPACE, Diagnosis of Affections of the.—The affections of the ham, requiring to be carefully distinguished from one another, may be grouped under the headings of *sinus* and *swellings*.

A *sinus* in the ham may be the sequel to a simple or a lymphatic abscess, or may be connected with necrosis of the lower end of the femur, or with disease of the knee-joint. To determine the question, the general outline of the joint and bones, the degree of mobility of the joint, and the history of the case must be made out, and the sinus should be carefully probed. Where there is no enlargement of the bones or joint, and the movement of the joint is painless and free from grating, and the probe fails to detect any bare bone, it may be regarded as a *simple sinus*. With a sinus present, the joint may be held flexed and complete extension be impossible, owing to contraction of the ham-strings and the matting together of the parts around the sinus. Unless the sinus be very carefully probed, a small surface of bare bone may be overlooked. If, however, the probe strike bare bone, the diagnosis of *necrosis* will be arrived at. Necrosis of the flat popliteal surface of the femur is very common, and when it occurs, no involucrum of new bone is formed around the sequestrum. Where, with a sinus, there are the usual signs of disease of the knee—swelling, rigidity, pain, grating in the joint—the dependence of the sinus upon the *arthritis* will be evident.

Swellings.—It is most important to determine whether any given swelling is connected with the popliteal artery or not, and no pains must be spared in this investigation. The chief sign of such connection is pulsation in the tumour. Pulsation may be due to one of three causes—(1) Contact of a tumour with the main artery; (2) extreme vascularity of a solid tumour; (3) communication with the artery—aneurism. (1) When the pulsation is communicated, it is heaving in character, and the tumour is not expanded with a wave; compression of the main vessel does not cause the tumour to shrink, and, except in the case of reducible bursal cysts, the tumour does not yield under compression. In the latter case, the tumour is reducible when the artery above is not compressed. In many

of these cases the pulsation is limited to or most intense in one part of the swelling, and can be increased by gentle pressure; it is often possible to draw the tumour away from the artery, and cause the pulsation to disappear. Such tumours have no thrill, and, if a bruit be heard, it is a dull thud rather than a prolonged blowing sound; the pulse in the artery beyond is not modified.

(2) When pulsation is due to the vascularity of a tumour, it is somewhat expansile in character; but, on controlling the artery above, the tumour is quite unaltered in size and consistence, and is incompressible; on removing the pressure above, the pulsation at once returns as before. Often other special signs characterise these tumours—thus the pulsation may occur at a distance from the main artery, or there may be 'egg-shell crackling' at some part of the tumour.

(3) When the pulsation is due to aneurism, it is always expansile in character, and is felt as a wave distending the tumour, and generally it is uniform in intensity throughout the tumour. On compressing the femoral artery, the tumour contracts somewhat, and by gentle compression it can be made to yield still more; then, when the pressure above is removed, the tumour is filled out again in two or three bounding beats. Such tumours generally are the seat of a prolonged blowing bruit, and often of a thrill. The pulse in the arteries below is delayed in time, and lessened in force and size as compared with that in the opposite leg. From pressure on the vein or nerve there are often cyanosis and oedema of the leg, and neuralgic pains in the foot and ankle. See **POPLITEAL ANEURISM**.

A. Sudden Swellings.—Where in a previously healthy man a deep tense swelling suddenly develops as a result of a blow, strain, or other injury, and the leg below is found pulseless, cold, swollen, and livid, with numbness gradually becoming complete, the diagnosis of *rupture of the popliteal artery* may be made. Should there have been some amount of swelling in the ham before, or the patient have been conscious of a beating in the part, or subject to neuralgic pains in the leg and foot; and especially if the patient be at or past middle life, and have atheromatous arteries and hypertrophy of the heart, it may be regarded as a *ruptured aneurism*.

B. Acute Swellings.—Should the swelling be deep in the ham, painful, tender, the touch firm, and without superficial oedema, and with only communicated pulsation, if any at all, it is a *bubo* or en-

larged popliteal gland. The detection on the heel or ankle of some source of infection would support this diagnosis. If the swelling be less well-defined, boggy or fluctuating, painful, tender, and the superficial tissues be cedematous and reddened, an *abscess* may be diagnosed. In this condition the joint will be semi-flexed, and any attempt to straighten it out will be painful, and resisted by the patient. There will be pyrexia, and perhaps a rigor or rigors, to confirm the diagnosis. An abscess may be combined with aneurism, or may open into the artery. The surgeon should therefore carefully examine for pulsation, thrill, bruit, and especially for compressibility of the tumour when the artery above is controlled, and for alterations in the tibial pulse. Only when he has ascertained the absence of *all* these phenomena, must he diagnose abscess pure and simple.

C. Chronic Swellings.—A soft, rounded, compressible swelling, immediately beneath the skin, which is continuous with the saphena vein in the leg, is a *varix*.

If the tumour be subcutaneous and loosely adherent to the skin, movable over the deep fascia, with a lobulated surface, and a defined, rounded smooth edge, it is a *lipoma*. A soft, ill-defined, lobulated swelling at the back of the knee, adherent to the skin, and immovable in the subcutaneous fascia, is of no pathological importance.

A tense, more or less globular fluctuating tumour, painless and not tender, without any signs of connection with the blood-vessels, unless it be transmitted pulsation, is a *bursa*. This form of tumour is often reducible into the joint, and is most tense and prominent when the joint is extended. A firm, solid tumour deep in the ham, movable over the artery, with doubtful transmitted pulsation, is an enlarged *lymphatic gland*.

A very hard tumour, growing slowly from the bone in a young person, is an *exostosis*. These tumours may be multiple; they may cause severe pain by pressure on a nerve. Occasionally an exostosis is broken off by violence.

A firm, steadily increasing tumour, fixed to the bone, or expanding the bone over it, perhaps varying in consistence in different parts, is a *sarcoma*. Such a tumour may exhibit pulsation from its great vascularity; it may attain a great size, and involve more of the femur or tibia than its popliteal surface.

A tumour over, and irremovable from, the artery, with expansile pulsation, blow-

ing bruit, and thrill, yielding to pressure when the artery above is compressed, and subsequently filling out with two or three bounding beats, is a *POPLITEAL ANEURISM*.

A. PEARCE GOULD.

PORRO'S OPERATION.—This is the Cæsarean section together with supra-vaginal amputation of the uterus and removal of the ovaries and tubes. It is indicated in the same cases in which the CÆSAREAN SECTION, LAPARO-ELYTROTOMY, or SYMPHYSIOTOMY (Sigault's operation) may be performed; and, besides avoiding certain special dangers pertaining to each of these procedures, has the further recommendation that the patient cannot again become pregnant and be exposed to the same risks a second time. Another great advantage, which it possesses over any of these alternative operations, is that it can be performed at a fixed time selected by the surgeon, without waiting for the actual commencement of labour.

The possibility of performing this operation, and thus lessening the danger of the Cæsarean section had at various times suggested itself to Cavallini, Michaëlis, and our countryman Blundell, who was so far in advance of his time in many of his thoughts and writings on abdominal surgery. Storer, of Boston, U.S., in 1869, was the first operator who actually performed the operation on a living woman, having been forced to remove the uterus to check the hæmorrhage during Cæsarean section; the presence of a large uterine fibro-cyst being the cause of the hæmorrhage. The patient survived sixty-eight hours.

To Porro, of Pavia, the credit belongs of having first performed Cæsarean section, with the intention of also amputating the uterus and its appendages. His operation was performed on May 21, 1876, and both mother and child survived.

In the *British Medical Journal*, January 26, 1884, Dr. Godson records a successful case in which the writer assisted him; and he gives very complete tables of all the cases which he could collect. A study of these tables shows that, though the maternal mortality of the operation has been very heavy, it compares favourably with that of the ordinary Cæsarean section.

Operation.—The bowel having been cleared by enema, and the bladder emptied by the catheter, the patient is laid on her back, with the arrangements which will be found described in detail in the article on OVARIOTOMY. An incision five inches long

is made through the linea alba, bleeding points are secured by pressure-forceps, and the peritoneum is carefully opened to the same extent as the skin-incision. The possible escape of any of the contents of the uterus into the peritoneum is guarded against by placing carbolised sponges in the peritoneum, between its parietal surface and the uterus, all round the space selected for incision. A small incision is then made in the uterine wall, and rapidly enlarged by tearing with the two index fingers (a modification suggested by the writer during Dr. Godson's operation); the child is then seized and extracted, and handed to an assistant, who ties and cuts the umbilical cord. As the operator removes the child, the chief assistant grasps the uterus and closes the uterine incision, covering it by a sponge; he at the same time slips one hand past the uterus into the pelvis, and grasps it firmly just above the vagina, including in his hand the broad ligaments on each side; all risk of any serious hæmorrhage is thus prevented. The upper margin of the bladder, at its reflection from the uterus, should now be defined by a catheter or a steel sound, introduced before commencing the operation, and the wire of Kœberlé's *serre-nœud* passed round so as to include the uterus just above the internal os, and both broad ligaments, with the contained appendages. The wire is first pulled as tight as possible with the special forceps, and its free end is passed twice round the catch on the *serre-nœud* central screw, and then twice round the whole stem of the instrument, which is then screwed up; a strong capped pin, like that described for hysterectomy, is passed through the right broad ligament, the uterus just above the wire, and the left broad ligament, and the cap is screwed on. The uterus, with the placenta left *in situ*, is then cut away. See UTERUS, Extirpation of the.

The sponges are then removed from the peritoneum, the anterior and posterior *cul-de-sacs* are sponged out, a flat sponge is placed over the intestines, and the pressure-forceps are removed from the edges of the incision. The sponges and forceps are carefully counted by the nurse or assistant. The *serre-nœud* is tightened if necessary, and the stump is fixed in the lower angle of the wound by a strong suture passed through the whole thickness of the abdominal wall and the edges of the peritoneum, so as to close the latter firmly round the stump without constriction. The remaining sutures are introduced, and the flat sponge removed. After the sutures are tied, and the upper

part of the wound dressed and strapped, dry carbolic gauze is carefully packed round the stump, and under the stem of the *serre-nœud* and the supporting pin. The wire is then again tightened if necessary, and the stump trimmed; a silk thread is run in and out round the cut edge of the broad ligament and uterine stump, and firmly tied. The stump is then lightly and carefully smeared with solid perchloride of iron, and covered with the usual dry carbolic gauze dressing and straps.

The after-treatment is exactly the same as after hysterectomy. Various modifications of the operation have been proposed, but they have nothing to recommend them. One, that of Müller, requires a brief notice.

He makes a longer incision, turns the uterus out entire, and surrounds its neck with an elastic ligature before opening it and removing the child, the object being to save risk of hæmorrhage and of fouling the peritoneum with the uterine contents. The great objection to this is that the child is often asphyxiated by the elastic ligature stopping the uterine circulation, and the fear of this must always hurry the operator while applying the ligature, incising the uterus, and extracting the child. Such hurry is always to be avoided; and the risks above referred to (hæmorrhage and fouling of the peritoneum) may be equally well obviated by the careful arrangement of sponges, by the tearing of the main part of the uterine opening, and by grasping the uterus in the pelvis as described above.

The long incision necessitated by the Müller modification, apart from the danger to the child, increases the shock, adds to the exposure of intestines, to the length of the operation, from the number of sutures required, and exposes the patient to increased risk of hernia from the long scar.

One of the great advantages of the Porro operation is that all proper arrangements as to skilled assistance, &c., can be made beforehand, and thus no difficulty should arise in carrying out each detail with precision and care.

Drainage should never be necessary after an operation carefully performed, when necessitated by contraction or deformity of the bony pelvis; but may in rare cases be required when a large adherent tumour has been removed along with the uterus. In such cases the operation may have to be modified in many ways, and it may even be necessary to adopt Schröder's intra-peritoneal method of amputating the uterus; but a detailed discussion of all such eventualities would occupy too much space in the

present article, and they only require the application of the rules laid down in the articles on OVARIOTOMY, and UTERUS, Extirpation of the.

J. KNOWSLEY THORNTON.

POSITION interests the surgeon in diagnosis and treatment. Position in bed is frequently suggestive of the constitutional state. A patient sleeping on the back, with hands clasped behind the head, or resting on the side, with open hand under the face or temple, is generally doing well. After injuries and operations in the abdomen, the position on the back with down-stretched legs is of good omen; so is lying on the side with sufferers from chest-lesions. In advanced cases of tetanus, the backward arched position of the body is pathognomonic; but, even in early trismus, the patient's complaint of slight stiffness about the jaws acquires special importance, if the chin project and the head be thrown a little backward. In serious cases generally, the patient's high or low position in bed indicates power or feebleness; and, in determining the nature of many injuries, the position of parts may be one of the most obvious signs—e.g. in dislocations of the lower jaw, of the shoulder, elbow, and hip; so also in fractures of the lower end of the radius, and just above the ankle. In diagnosing the presence of tumours or collections of fluid in the chest or abdomen, much valuable information is gained from the influence of varying positions of the body on palpation and percussion.

The diagnosis of many tumours and ulcers is largely determined by position. The scalp is the favourite seat of cystic, the trunk of fatty, tumours. The majority of herniæ are on the front of the abdomen, of aneurisms at the bends of joints. The almost invariable domain of varix is the lower half of the body; the upper half is the favourite one of scrofula. Ulcers are rare in the upper limbs, and their position on the lower is in a large measure diagnostic. They are usually varicose below, and syphilitic above, the middle of the leg.

The operating surgeon has to consider position in making incisions, so as to prevent deformity, pain, and tension, and favour drainage by natural declivity. In operating on the face and neck, it is best to follow the natural lines; on the hand and foot, to elect the dorsal aspect, whenever practicable, so as to avoid cicatrices on the surface exposed to pressure. A similar consideration should influence the surgeon in planning his incisions for amputations. Position is of the

first importance in exploring and operating in the natural passages, in the administration of anæsthetics, and in treating aneurism, dropsy, hæmorrhage, hernia, and spinal and uterine affections and displacements; also in restoring persons whose lives are endangered by asphyxia or faintness.

In the treatment of wounds and fractures, and generally of surgical conditions, position is a potent factor, regulating nervous, vascular, and muscular action, preventing congestion, facilitating coaptation, and, in direct measure, favouring repair, with a minimum of constitutional and local disturbance.

'An elevated position, of any part of the body which admits of being raised above the rest, has effects far beyond what are generally known on the circulation of the elevated part, and consequently on the heat, pain, and tumefaction which may have previously existed. If the hand be held up for a little time above the head, the pulse immediately becomes soft. The hand is soon after found to be pulseless and reduced in size. There is a feeling of lightness and coldness, which continues for some time after the hand has been taken down.' This very simple experiment, related by James Macartney in his *Treatise on Inflammation* (1838), is full of instruction and suggestiveness, as to the value of position in surgical therapeutics. A purple and swollen leg has been proved to decrease one inch in circumference, at the expiration of sixty seconds from the time that an assistant held the foot vertically above the pelvis, the skin at the same time becoming pale and the previously tense tissues flabby. As a contributory to rest, position is potent for good, all the more so if circumstances permit the application of equable pressure. As a general rule, that position is therapeutically the best which is most conducive to the patient's comfort. See PRESSURE; REST; SUSPENSION; WOUNDS, Treatment of. SAMPSON GAMGEE.

POSTHITIS — Inflammation of the Prepuce. See BALANITIS.

POST-MORTEM WOUNDS. See POISONED WOUNDS.

POST-PHARYNGEAL ABSCESS. See RETRO-PHARYNGEAL ABSCESS.

POTT'S DISEASE. See CARIES OF THE SPINE.

POTT'S FRACTURE. See LEG, Fractures of the.

POULTICES are hot, moist, local applications, which may be employed solely on account of the heat and moisture which they possess, or less commonly as vehicles for some special therapeutic agent. The poultices recognised by the pharmacopœia may be classified as *emollient*, *sedative*, *stimulant*, and *disinfectant*.

Emollient poultices are made of linseed-meal, bread, or starch. Their therapeutic effects depend entirely upon the heat and moisture which they contain, and, so long as the skin to which they are applied is unbroken, they form very efficient applications. They relax the tissues, and so relieve the tensive pain of inflamed parts; they also, by virtue of their heat, stimulate the vital processes of those tissues which are not too much injured to respond, and thus either aid the resolution of inflammatory products or hasten their approach to the surface. These properties they share in common with fomentations, and with the above reservation—viz. that the surface to which they are applied be unbroken—they are equally efficacious. Poultices retain their heat longer than fomentations, unless special care be taken to prevent the cooling of the latter by surrounding them with cotton-wool. This property is a great recommendation in cases where the frequent renewal of a fomentation disturbs the patient a good deal, or where the regular attendance of a nurse cannot be obtained. If the skin be ulcerated or the seat of any open wound, a poultice is an objectionable application, as it very quickly becomes sour and favours putrefaction of the discharges from the wound. When a poultice is changed, small fragments are very commonly left in the folds of the skin, between the clefts of the fingers, and under the nails for days together, and these, together with the discharges with which they are mixed, become centres of decomposition. Linseed poultices often irritate a tender skin, and frequently cause an eruption of irritable papules, which are liable to develop into boils.

A linseed poultice is best made as follows: The basin used should be well scalded and about half-filled with boiling water; linseed-meal from which the oil has been expressed should be dredged into the water, whilst the mixture is vigorously stirred with a spatula until a soft and tenacious pulp is produced. The linseed should then be quickly and evenly spread on a piece of linen, so as to make a poultice about one-third of an inch thick; the edges of the

linseed should be trimmed off, and the borders of the linen should be turned up on to the face of the poultice; the surface of the poultice should be smeared with a little olive-oil, so as to prevent it sticking to the skin. The poultice should be quickly applied, and covered over with a layer of oil-silk, so as to prevent the evaporation of its moisture.

A linseed poultice is very close-textured and heavy, so it is important that it should not be made any thicker than is necessary to obtain its heat-retaining properties.

A bread poultice is more porous and consequently lighter than a linseed poultice, but it retains more moisture than the latter, and soddens the skin much more. To make a bread poultice, the crumb of a loaf two or three days old should be well powdered and dredged into a basin of boiling water, and well stirred up until a pulpy mass is produced; all superfluous moisture should be drained away, and the bread quickly spread on linen, and covered with a piece of muslin so as to prevent its falling to pieces.

Starch poultices are not much used. They retain their heat a long time, but they yield very little moisture. The starch should be first mixed up with a little cold water, and then boiling water should be well stirred in until the starch acquires a gelatinous consistence; the further steps in the preparation of a starch poultice resemble those described for the preparation of a linseed poultice.

Sedative poultices contain some substance which acts locally as a sedative. The only official poultice of this kind is made of conium. Two ounces of the extract of conium should be mixed with a pint of boiling water, and then sufficient linseed be added, in the way described above, until a poultice of the proper consistence is made. Other anodynes, such as the tinctures of opium or belladonna, may be added to poultices.

Stimulant poultices are made of powdered mustard, when a strong stimulant or counter-irritant effect is desired; but both yeast and carrot poultices are credited with slightly stimulant properties, and have been used as local applications to sluggish or sloughing wounds. The efficacy of yeast poultices is thought to depend on the carbonic acid which is slowly evolved during the process of fermentation. Mustard poultices are strong counter-irritants, and they cause much pain when applied to a tender skin; they are also liable to produce troublesome vesication if they are

apt on too long; as a rule they cannot be borne for more than twenty minutes.

Mustard poultices are employed to influence deep-seated inflammations, such as pneumonia or bronchitis; to stimulate a failing heart, or as a general stimulant in low fevers when stupor or delirium are present, or to rouse a patient from the stupor resulting from narcotic poisons. To make a mustard poultice, the powdered mustard should be well mixed with cold water, which should be added gradually until a thick paste is produced; hot water should on no account be used, as it causes the active principle of the mustard to evaporate. Vinegar, which has been recommended for making mustard poultices, is still more objectionable, as it destroys the active principle. The mustard paste should be spread on a piece of brown paper and warmed by a short exposure to a fire before it is applied, as the chill of a cold application might be objectionable.

When a mustard poultice is employed to modify a deep-seated inflammation, the poultice should be diluted with bread or linseed, and applied for five or six hours as a jacket-poultice to the entire chest.

The *disinfectant poultices* authorised by the pharmacopœia, are made of either charcoal or a solution of chlorate of soda mixed with linseed and water, but the oakum poultice is far better than either of these. Charcoal in a dry state is well known to absorb gases, but it is questionable whether it retains this power when its pores are filled with moisture, as must be the case in a poultice; it is also questionable whether it possesses any true disinfecting power at all. At the best, a charcoal poultice is an unsightly application, and is very inferior in its action to many modern antiseptics; it is far preferable to wrinkle the wound with crystals of iodoform, and to apply a fomentation over all, than to make use of a charcoal poultice.

To make a charcoal poultice, equal parts of animal charcoal and linseed-meal should be thoroughly mixed and dredged into a basin of boiling water, just as in making a simple linseed poultice.

The chlorate of soda poultice is composed of two ounces of the solution of chlorate of soda, four ounces of linseed meal, and eight ounces of water. It would, however, be far preferable to wash a foul ulcer frequently with the disinfectant than to apply it as a poultice.

The oakum poultice or fomentation is a very good antiseptic application; it is made of loosely picked oakum and pre-

pared, like a fomentation, by wringing it out of boiling water; it is well to wrap up the oakum in a piece of muslin before applying it to a wound, as its fibres are very liable to stick to the surface.

BILTON POLLARD

PRESBYOPIA.—This name is given to the optical defect of the eye which is caused by natural senile changes in the crystalline lens, in consequence of which changes the nearest point of distinct vision recedes from the eye. These changes consist chiefly of gradual hardening of the lens. This hardening process really goes on throughout life, with the result of causing a progressive diminution in the amplitude of accommodation, as the nearest point of vision recedes. The far point of distinct vision remains stationary until the age of fifty and then it also recedes, but more slowly than the near point, so that at the age of seventy-five the near and far points coincide—i.e. the amplitude of accommodation equals 0. When the near point has receded beyond 22 centimètres (about 9 inches) from the eye, which would correspond in a case of emmetropia to a remaining amplitude of accommodation equal to 4.50 dioptries, a difficulty is experienced in seeing small objects, such as small print, fine stitches, &c. This difficulty is first noticeable when the illumination is not good, e.g. during the evening, when artificial light is employed. It becomes necessary, under these circumstances, to supplement the existing amount of accommodation by means of a lens whose focal power, when added to one the focal distance of which equals the distance of the near point from the eye, is of sufficient strength to make that combination equivalent to a lens of 4.50 dioptries. In other words, we must place in front of the eye a lens which is sufficiently strong to bring the near point to 22 centimètres from the eye. Thus, for instance, if the near point be at 50 centimètres from the eye—i.e. equals the focal distance of a lens of 2.0 dioptries—it must be brought to 22 centimètres from the eye, which again equals the focal distance of a lens of 4.50 dioptries. The lens which will effect this has a refracting power equal to the difference between 4.50 and 2.0—i.e. equal to a lens of 2.50 dioptries.

Recourse will have to be taken to such aid sooner or later, and the actual glass required will have to be stronger or weaker according to the age at which the near point has receded beyond 22 centimètres from the eye. In hypermetropia this will

take place at an earlier age than in emmetropia, and earlier according to the degree of hypermetropia; in myopia, on the other hand, it will take place later than in emmetropia and later according to the degree of myopia. The condition of presbyopia is generally said to exist when such a glass is required as an aid to near vision, although more correctly it has begun when the same optical correction is not sufficient for both distant and near vision. The following table gives the number of the lens (in dioptries) generally required at different ages:—

Age		Age	
45 . .	1·00	65 . .	4·75
50 . .	2·00	70 . .	5·50
55 . .	3·00	75 . .	6·50
60 . .	4·00	80 . .	7·00

If the individual be ametropic and x represent the number in dioptries of the lens correcting his ametropia, x must be added to the lens given in the table for any particular age in the case of hypermetropia, and subtracted from that number in the case of myopia.

There are some special points which should be attended to in testing and prescribing glasses for presbyopia, viz.:—

1. The proper test to use, when the vision is good, is very small print (e.g. No. 1 Jaeger), as in order to read this there must be accurate fixation.

2. Care must be taken not to prescribe too strong glasses, as they are frequently resented, the reason probably being that the individual has always been accustomed to converge towards and accommodate for the same distance simultaneously; and as the defect in accommodative power is due to want of elasticity of the lens and not to weakness of the ciliary muscle, the correcting glass should not be stronger than the difference in the amount of accommodation which the contracted muscle actually effects, and that which it would bring about, did a sufficient elasticity in the lens exist. Any unwonted dissociation of the relation existing between accommodation and convergence gives rise in the long run to discomfort, which is the more felt the older the individual by whom the change has to be made.

3. Great care must also be taken that the two eyes are corrected for the same distance: this will generally be the case by the use of the same glasses, as the refraction is generally the same in both eyes, but it is a good precaution to test either eye separately. It is still a disputed point whether, in the interest of binocular vision,

each eye is capable of an independent amount of accommodation or not; in any case, it is pretty certain that, if such independence exist, it is only brought into play by more or less effort. If we do not bring the near point of both eyes to the same distance, we must have either defective or strained binocular vision. As long as there is a certain amplitude of accommodation left, there will also be a greater or less range through which the individual has distinct vision while using his glasses, as, although the eye provided with a convex glass has a smaller amplitude of accommodation than without, yet the diminution in the amplitude is but slight. Convex glasses magnify for two reasons—first, and principally, because they allow the individual to approach the object closer to the eye, but also because they cause the second nodal point of the eye to advance, and thereby increase the visual acuity; and this to a much greater extent than is done by the change in the crystalline lens, sufficient to give rise to an accommodation for the same distance.

G. A. BERRY.

PRESSURE.—As a cause of pathological states, a means of diagnosis, and a therapeutic power, pressure merits the closest attention of the surgical student and practitioner. It has been usual to divide the subject under 'compression' and 'pressure'; but these are essentially synonymous terms, only admitting of artificial distinction in science and practice. Pressure is the least ambiguous term, and its preference may, it is hoped, result in clearness of statement and economy of space.

As a cause of pain and functional disturbance in many constitutional states, and as the prime mover or concomitant in structural changes after injury, pressure operates variously, according to its intensity and duration and to the parts or tissues acted upon. In abscesses, cysts, and dropsies; in aneurisms and varix; after lesions of the nervous centres and of the thoracic and abdominal viscera; in atrophy and hypertrophy; contusions, dislocations, and fractures; in hernia and prolapsus; ulceration and gangrene—in fact, in the great majority of surgical states, pressure is an etiological factor deserving close investigation.

In the endeavour to determine if, and to what extent, pressure be the cause of pathological phenomena, accurate comparison of analogous parts of the body is very instructive. So, too, are measurement and palpation, auscultation and percussion:

in different positions, and examination of the organs of special sense and of the visceral cavities by instrumental aid. Light and deep tapping and grasping, dilating and concentric pressure, have distinctive diagnostic values; and the surgical student cannot be too assiduous in training his fingers to the exercise of intelligent pressure. The touch is scarcely more important to the pianist than to the surgeon: a proposition very forcibly demonstrated in the study of the therapeutic uses of pressure.

The coaptation of divided parts, the crushing and dispersion of a ganglion on the wrist, truss retention of a hernia, dilatation of strictures by bougies, injection of air or oil per rectum in cases of intussusception, are some of the most striking and varied illustrations of the mechanical action of pressure. Its other therapeutic uses, in combination with immobility and position, antiseptics and styptics, are *hæmostatic*, *antispasmodic*, and *antiphlogistic*.

In all methods for arresting hæmorrhage, by bandage, pad and tourniquet, pressure is the chief agency, to which physiological position and immobility are powerful contributors. The swelling which takes place immediately after a bruise or sprain is due to subcutaneous hæmorrhage, which is most efficiently controlled by uniform pressure and immobility. Nothing is more soothing to an injured joint, nothing more powerfully conducive to the balance of innervation and circulation, to the prevention of extravasation, and to its removal when it has taken place, than gentle, equable, elastic pressure. Much depends upon how, and with what materials, pressure is applied. If a limb be firmly bandaged with a strong calico roller, without padding, or over ordinary pads or dense common wadding, against wooden or iron splints, the risk is unquestionable; but perfect ease and safety may be ensured by applying pressure with light absorbent bandage, and absorbent gauze and cotton tissue, over well-fitting moulds. Pressure so applied is hæmostatic, anti-spasmodic, and antiphlogistic. Pressure is, by common mission, one of the most powerful therapeutic agencies in counteracting the effects of chronic inflammation; but its efficacy in preventing and treating acute inflammation, though equally demonstrable, is not generally known. No other triple combination in surgical therapeutics rivals in efficient power rest, position, and pressure. As to the degree of pressure to be applied, the patient's comfort must be the measure

in each case. Nothing in surgery is more noteworthy than the considerable amount of well-applied, equable, elastic pressure which may be borne, with the most perfect comfort, by a part just previously so sensitive that the slightest touch was intolerable.

When pressure causes pain, that is a proof of excess, and it should be at once lightened. It is misleading, and often dangerous, to wait for the relief of numbness which may succeed the patient's endurance of painful pressure. Such numbness may only indicate impaired vitality, and be the immediate precursor of structural disorganisation.

Well-adjusted elastic pressure is of great value in the treatment of such diverse conditions as simple flesh-wounds and complicated fractures, ingrowing toe-nail and burns, bubo, and carbuncle. Digital compression of arterial trunks is a powerful antiphlogistic, and gives relief, though often only auxiliary to other remedial measures, in whitlow and phlegmonous erysipelas, in arthritis and compound fracture. From the combination of equable elastic pressure of the surface, digital compression of the main artery, immobilisation of the joints and elevation of a limb, the most beneficial results may be anticipated in removing pathological products and restoring the physiological state.

Pressure may be applied in a great variety of ways. The most generally useful are bandaging with efficient padding or with india-rubber; strapping, adjustment of air- and water-cushions, or of bags filled with ice, sand, or shot. The pressure exercised by successive layers of freshly-applied collodion is considerable. Its antiphlogistic action is very beneficially demonstrated in the treatment of acutely swollen testicle, and it makes the best retentive and immobilising shield for fractures of the nose. *See POSITION; REST; WOUNDS, Treatment of.*

SAMPSON GAMGEE.

PROBANGS are instruments used to dislodge or extract foreign bodies from the œsophagus. The sponge probang consists of a long flexible piece of whalebone with a small sphere of sponge attached to one end; it is used to dislodge soft bodies, such as pieces of meat, which have become impacted in the lower part of the œsophagus, and to push them into the stomach. The horsehair probang is an ingeniously contrived instrument for extracting pins or fishbones from the gullet. The point of the instrument is protected by a small piece of sponge, and about an inch away

from it there is a wisp of horsehair, which can be made to open out something like an umbrella. After the instrument has been insinuated past the foreign body, the umbrella is made to spread out, and then the instrument is withdrawn, in the hope that the foreign body may become entangled in the meshes of the horsehair and so be removed.

An instrument known as a coin-catcher is usually combined with the sponge probang; it consists of a flat flexible piece of whalebone, at the extremity of which there is a metal ring, fixed at an acute angle with the whalebone. The best instrument is provided with two rings, which make an angle of about sixty degrees with one another, and are fixed by a hinge to the extremity of the probang; the hinge allows of one of the rings falling flat against the whalebone, if it meets with any obstruction as it is passed down the œsophagus. When the instrument is withdrawn, it is hoped that the coin may be caught by one of the rings and so be removed.

BILTON POLLARD.

PROCTITIS (Inflammation of the Rectum).—It is a symptom of many affections of the rectum, such as hæmorrhoids, polypus, prolapse, stricture, ulceration, &c., but may also occur independently of these, from local or general causes. It may be due to the introduction of foreign bodies into the rectum, or to the irritation caused by oxyurides, or to gonorrhœal infection. It may also be caused by large and repeated doses of drastic purgatives, or in some persons by errors of diet; or may be associated with diphtheria, gout, or constitutional syphilis. Gouty and diphtheritic proctitis come under the notice of physicians rather than surgeons. Constitutional syphilis sometimes appears to produce this condition. A young married lady who had lived for some years abroad, lately consulted the writer for a painful condition of the rectum, accompanied with a profuse purulent discharge which had persisted for six months. The sphincter muscles were firmly contracted, and the mucous membrane was hot and swollen. No breach of surface, piles, or other exciting cause could be discovered. As ordinary treatment for inflammation had previously failed, and as the history of the patient suggested the probability of some syphilitic taint, the writer prescribed five-grain doses of iodide of potassium thrice daily and a suppository of iodoform ointment to be inserted at bed-time. The painful sensations ceased

almost immediately, and the discharge gradually diminished, and finally disappeared in about three weeks.

Gonorrhœal inflammation may be caused directly by unnatural intercourse, or accidentally from a vaginal or urethral discharge. It is more frequently met with in females, as a vaginal discharge would, when the patient was in the supine position, gravitate towards the anus. The chances of rectal infection would be greatly increased by the existence of prolapse or piles. In males, the infecting material might be carried by the fingers of the patient to the anus. It is characterised by a profuse purulent discharge, and by burning and smarting sensations. The existence of a vaginal or urethral discharge, or a recent history of such, would indicate the cause.

Proctitis may be acute or chronic. In the *acute* form the patient experiences a sensation of weight and heat in the perineum, and pain in defæcation. The sphincter muscles are usually firmly contracted, and the mucous membrane is hot, dry, and congested. A few small flakes of brownish mucus usually adhere to the finger of the surgeon, when withdrawn after digital examination of the bowel. This stage is usually succeeded after a few days by the *chronic* form. The sphincters are not firmly contracted, and may sometimes have lost some of their contractile power. The mucous membrane is cedematous, and there is a discharge of either gelatinous lumps of mucus, or of a mucopurulent or purulent fluid. This may escape either during defæcation, or, if the orifice be patulous, constantly, and so excite irritation and excoriation of the adjacent cutaneous surfaces.

Treatment.—In the acute stage, leeches to the perineum and warm baths will give relief. When the spasmodic contraction of the sphincter has subsided, lukewarm injections with, in adults, some laudanum, will be of service. In the more chronic stage the discharge can be arrested by injections of alum or of weak solution of nitrate of silver. The diet must be simple and such as will not leave a bulky residue, and alcoholic stimulants must be prohibited. If the inflammation has been excited by worms or some constitutional taint, appropriate remedies must be employed as well as local treatment. JEREMIAH MCCARTHY.

PROLAPSUS ANI et RECTI.
Eversion of the mucous membrane of the anus or of all the constituent structures of the rectum through the anal orifice.

The mucous membrane of the anus and rectum is attached to the other structures of the bowel by very lax connective tissue, so as to admit of its adaptation to the varying calibre of the tube. It is normally slightly everted during defæcation, and withdrawn again at the conclusion of that process by fibres of the tunica mucosæ muscularis, which are considerably developed at this part of the alimentary canal.

In feeble, unhealthy children, from the irritation of diarrhoea, or of oxyurides in the rectum, or of a calculus in the bladder, the mucous membrane may be more largely everted, and require adventitious aid for its replacement. This may also occur in adults from the like causes, or from the training resulting from constipation, rectal or urethral stricture, or prostatic enlargement. Prolapsed piles and rectal stricture also tend to produce this eversion. This condition is termed *prolapsus ani*, to distinguish it from eversion of all the structures of the rectum, which is known as *prolapsus recti*. This latter condition may result from congenital or acquired want of tone in the sphincter, levatores ani, and recto-coccygei muscles. It sometimes occurs in young persons from some congenital defect in these muscles. In adults it may result from some acquired want of muscular tone, especially in women who have borne many children. A large rectal polypus would also tend to produce it. The everted bowel necessarily draws with it, in the male, the recto-vesical and, in the female, the recto-vaginal fold of peritoneum. If the protrusion be considerable, this fold may be drawn through the anal orifice and so form a hernial sac, into which a loop of intestine or some of the pelvic viscera might fall. If, from inflammation of the surrounding structures, or from contraction of the sphincter ani muscles, the neck of this sac should become constricted, strangulation of the contents of the sac might result, and form a serious complication. The prolapsed bowel forms a spherical or cylindrical mass, projecting in extreme cases many inches from the anus.

The symptoms vary with the degree and condition of the protrusion. There is always a disagreeable sensation as of some foreign body at the fundament, and there may be mucous, purulent, or sanguineous discharge. If the protruded part become inflamed and ulcerated, there is local pain and general feverishness. This is naturally greater in prolapsus recti, from the greater amount of protruded mucous surface and

vascular structures. If the protrusion be neglected, the submucous tissue will become loaded with leucocytes and inflammatory exudation, so that the replacement will be either difficult or impossible, and the continued exposure will tend to produce ulceration and increased inflammation; sometimes sloughing of the protrusion results. If it be complicated with a strangulated rectal hernia, the usual symptoms of this condition will be superadded, and the protrusion can be felt in the anterior wall of the prolapsed rectum.

The *diagnosis* does not present any difficulty. In ordinary prolapsus ani, the mucous membrane forms an annular uniform projection with central aperture. If it be caused by piles, the protrusion may not be uniform, and so the orifice may be eccentric. The condition is, however, very evident, and as the treatment will practically be the same as for the concomitant piles, the distinction is not of importance. Prolapsus recti may be confounded with protrusion of intussuscepted bowel through the anus. But in prolapsus recti the cutaneous surface will be either directly continuous with the upper part of the exposed mucous surface, or separated from it by a groove, of which the upper limit can readily be reached by the finger introduced along the projection through the anal orifice. In intussusception no such limit could be ascertained.

The *treatment* will vary with the condition of the part, and with the cause. The prolapsus ani should always be, if possible, reduced. In recent cases this is readily effected by pressure with a sponge. But if the protrusion be very congested, compression, with the interposition of some oiled lint, may be necessary, so as by squeezing out part of the blood and lymph to render the replacement possible. In young children, fright and pain may induce much resistance, which may be easily overcome by inverting the patient, and, if there be much spasm of the sphincter muscles, an anæsthetic should be administered. When reduction has been effected, the nates should be pressed together, and kept in that position by adhesive strapping. If the prolapse has been caused by some general irritation of the alimentary canal, a powder of rhubarb grs. iij. and carbonate of soda gr. j. will be useful. If there be oxyurides, the rectum should be washed out with an injection of salt and water, but as the rectal worms are only emigrants from the cæcum, some vermifuge should be also administered. A vesical calculus must be removed by lithotomy. Tonics and atten-

tion to diet will also be requisite. In children with a tendency to prolapsus ani, defæcation should always be performed in the supine position, and the child should not be allowed to sit during the process.

In adults, similar treatment must be employed, the prolapsus being reduced, and the exciting cause, so far as possible, removed. If the protrusion become inflamed and irreducible, rest in the recumbent posture, with the application of ice or warmth to the part, and opium either by the mouth or rectum, unless otherwise contra-indicated, will be necessary. When the acute symptoms have subsided, the protrusion, if it be still irreducible, must be removed by ligature or cautery in the manner described for internal hæmorrhoids. *See HÆMORRHOIDS.* When the exciting cause has been suitably treated, astringent injections may be of service, as well by checking the mucous catarrh, which usually exists, as by constricting the vessels of the part. The injections may be of oak-bark decoction or weak solutions of alum or tannic acid. They should not exceed three or four ounces, and should be administered at bed-time, so that they may be retained as long as possible. Sometimes, linear cauterisation of the anal mucous membrane is very beneficial. The actual cautery or nitric acid may be employed, and the number of lines of cauterisation must be regulated by the amount of the prolapse. The resulting cicatrization will contract the part so as to prevent any future prolapse. In more severe cases, portions of the mucous membrane may be excised in order to produce a similar result.

In prolapse of the rectum, all the symptoms of anal prolapse exist in an exaggerated degree. The bowel must be at once replaced if possible, and the patient should wear some artificial support for the part. Many contrivances have been devised for this purpose. Anal obturators only increase the evil which they are intended to remedy, and an elastic pad of suitable size, retained in position by a T-bandage, will probably be found to be the most effectual. The radical cure of this condition has been attempted in many ways. The simplest consists in excision of portions of the mucous membrane. For this purpose, the patient should be placed in the lithotomy position and anæsthetised. The operator should then take up a broad fold of mucous membrane at the side of the bowel with four-pronged forceps, and excise it with scissors curved on the flat. When all bleeding has been arrested, the lateral

margins of the divided mucous membrane should be united by interrupted sutures, and the operation repeated on the opposite side of the bowel, and, if necessary, also posteriorly. A morphia suppository should be then inserted into the rectum, and the patient kept in the horizontal posture until the wounds have healed. The patient should be carefully watched for several hours after the operation, as hæmorrhage may occur in the rectum to an alarming extent without any external evidence. If the patient become pale or faint, the rectum must be examined and, if there be hæmorrhage, the clot must be removed, and the bleeding vessel, if possible, ligatured. If this be impossible, solution of perchloride of iron should be applied, and the rectum plugged with pledgets of cotton-wool. This procedure is sometimes completely successful, but sometimes causes only partial relief. The general health must also be attended to, and the different preparations of strychnia may be given with benefit.

In neglected cases, the protrusion may be irreducible from chronic inflammation. Being exposed to injury or irritation, it may ulcerate or, if strangulated by contraction of the sphincter muscles, slough. If the removal of the projection by operation be considered advisable, the operator must remember that the weight of the mass draws down the bowel, which might, unless suitable precautions were employed, slip up out of reach when relieved of the weight. Well-waxed ligatures should therefore be passed through the projection a little above the line of excision, which can afterwards be used as sutures to unite the mucous and cutaneous surfaces. Drainage-tubes should be introduced between the sutures, to prevent the retention of any discharge, and the patient must be kept at rest until union has taken place. The possibility of a peritoneal sac must also be remembered, and careful digital examination made to ensure that it is empty. Prolapse of the rectum is, however, comparatively infrequent, and the hernial complication is very rare.

JEREMIAH MCCARTHY.

PROSTATE, Diseases of the.—**GENERAL VIEW.**—The prostate is a compound organ, being partly glandular, but chiefly muscular. The glandular portion secretes a fluid which lubricates the urethra prior to the venereal orgasm, and which also forms a part of the discharge emitted during the sexual act. The muscular portion assists in the expulsion of semen from

the urethra. The double function of the prostate being, therefore, sexual, its chief diseases are not met with before puberty. In the infant and child the prostate is very small; it is sometimes, although rarely, the seat of tumour or of the deposition of tubercle. After puberty, and up to fifty years of age, it is chiefly liable to inflammation and functional disturbance. It is not until after fifty that its liability to disease becomes of great importance, owing to its tendency to hypertrophy, and hence to cause difficulty in micturition. The prostate is seldom malformed; in extroversion of the bladder its anterior portion or roof is wanting, and if there is great lack of sexual and urinary development, the gland may be entirely absent. It is rarely wounded, except by the surgeon's knife in lithotomy, or by the improper use of catheters introduced through the urethra. It is very tolerant of injury, and little harm usually follows if the prostatic capsule remains intact. The average normal weight of the prostate is $4\frac{3}{4}$ drachms.

INFLAMMATION.—Acute inflammation is usually the result of gonorrhœa, and is most likely to occur if the patient has neglected himself, or has freely partaken of stimulants, or has used too strong urethral injections; but prostatitis may come on when every care has been taken in the treatment of the gonorrhœa, from its commencement. Other causes of prostatitis are, the application of caustic and other irritating solutions to the deep urethra, and the introduction of urethral instruments, particularly when very large or when roughly used. Severe stricture of the urethra, stone in the bladder, and prostatic calculi, are not infrequent causes. Sitting in a cold damp seat, especially when heated after exercise, excessive venereal excitement, and hard riding have all been known to cause this affection. Other causes, such as hæmorrhoids, ascarides, drastic purgatives, turpentine, cantharides and other medicines are often mentioned, but the evidence is unsatisfactory. A form of prostatitis, without very apparent cause, is not usually met with in middle-aged men who are habitually free livers; they may perhaps recently have been exposed to cold or damp, indulged in excessive venery, or been longer than usual in the saddle; but generally the attack cannot be definitely attributed to these causes. This condition has been called by some, not inappropriately, acute prostatitis.

Symptoms.—The most evident is an urgent, frequent, and painful desire to pass

water. The pain is not relieved by micturition, but rather aggravated by it. With the first flow of urine some muco-purulent matter passes, and with the last few drops a little blood may appear. There is usually considerable constitutional disturbance, and occasionally the demand for relief from pain is very urgent. Complete retention of urine sometimes occurs.

Prognosis.—The inflammation usually disappears, if actively treated. In some cases matter forms; this formation is often preceded by a definite rigor, and abscess is produced. In other cases the inflammation becomes chronic, with chronic pain and chronic urethral discharge.

Treatment.—Absolute rest must be enjoined, preferably in bed, but at least upon a couch. A hot sitz-bath should be taken twice or thrice daily, the bowels be freely opened, and doses of liq. potassæ (℞xx.-xxx.) in water administered every three or four hours, washed down by good barley water. The diet must be light, stimulants be forbidden, and, if gonorrhœa is present, urethral injections be abandoned. If the symptoms are severe, half-a-dozen leeches should be applied to the perineum, previously shaved and washed. As they fall off, bleeding should be encouraged by fomentations. If pain continues, an anodyne draught or suppository may be administered. Small doses of tartar emetic or of antimonial wine are often useful.

CHRONIC INFLAMMATION.—Acute inflammation may become chronic, which is characterised by painful and frequent micturition, sometimes by constant pain, and by the presence of a few muco-purulent shreds in the first flow of urine. Per rectum the prostate is found larger and harder than it should be, either symmetrically or on one side. Frequently, this condition is accompanied by sexual hypochondriasis, and the general health becomes seriously impaired. Sexual intercourse is often painful when the orgasm occurs.

Treatment.—A blister should be applied to the perineum, and kept open by a savin ointment dressing. A few cases are benefited by the careful introduction of a steel sound not larger than No. 11. Injections are useless. The general health must be maintained by cod-liver oil, iron, simple but nutritious food, and perhaps some sound red wine; a little blue pill, and an occasional dose of aperient salts, being given to those of full habit. Finally, as no organ can be healthy unless its function is regularly performed, the best and also most certain cure is a happy marriage.

ABSCCESS.—Acute prostatitis may run into abscess in from five to seven days. Pus may form in the follicles or in the parenchyma, or around the gland; or it may result from the breaking down of tubercular deposit, or from malignant growth or calculus in the prostate. Practically, suppuration in or about the prostate may be divided into acute and chronic abscess.

Symptoms.—In acute abscess all the symptoms of prostatitis are aggravated. There is always fever, and frequently a rigor. The difficulty in making water may increase until there is complete retention of urine. Chronic abscess generally comes on insidiously; it usually occurs in cases of prostatic hypertrophy, where catheterism is regularly practised. The patient has pain about the perineum, and is ill and complaining for some time before matter is detected. Prostatic abscess may spontaneously open into the urethra, rectum, bladder, or peritoneal cavity, or by the side of the anus, or forwards into the perineum. The writer has known prostatic abscess to fill one or both iliac fossæ, and to require opening in the groin like a bubo.

Diagnosis.—Fluctuation, in or about the prostate, is determined by a rectal examination with the finger. The operation is a painful one, and must be gently done, with the patient lying on his back and the finger well greased (not oiled). The swollen prostate will readily be defined. In chronic abscess, the prostate may appear only hypertrophied, and fluctuation may be difficult to make out.

Prognosis.—Acute abscess generally soon heals. Chronic abscess is much more serious, and not infrequently fatally exhausts the sufferer.

Treatment.—The soothing treatment of acute prostatitis must be vigorously carried out. Hot baths, poultices smeared with laudanum and belladonna, leeches, or wet cupping, a hot water enema and anodyne suppositories, may all be employed. Retention of urine must be relieved by catheter—if possible, by a soft one. Catheterism will often cause the abscess to burst into the prostatic urethra. No incision should be made until fluctuation is distinctly felt, unless the pain is so great that it seems desirable to relieve tension, for considerable thickening may undergo satisfactory resolution. Directly fluctuation is detected the abscess must be opened. If the matter is close to the rectum, it may be aspirated through the bowel or opened into the bowel with a small incision. If pointing towards the perineum or deeply seated, the surgeon

should pass his finger into the rectum and enter a sharp-pointed narrow bistoury into the perineum just in front of the anus; the knife will often have to pass in an inch or more before matter is reached. Tubercular, calculous, and ordinary chronic abscesses may sometimes require to be freely opened from the perineum and thoroughly cleared out and drained; in these cases a grooved staff should be introduced, and the patient held as for lithotomy.

URINARY FISTULA FOLLOWING PROSTATIC ABSCCESS.—After a prostatic abscess has been opened by the surgeon's knife, or has discharged spontaneously into the rectum, ischio-rectal fossa, or perineum, the case is not always at an end; for frequently, if it is not further treated, troublesome urinary fistula results, and great care will often be necessary to prevent this unfortunate consequence. The external opening of the abscess-cavity must be watched, in order to observe if any urine issues during the act of micturition. The patient's account must be verified by the surgeon's own inspection while water is being passed. If urine issues, the urethra must be examined for stricture, and if any is found, it must be treated immediately by internal urethrotomy or interrupted dilatation; for as long as stricture exists, so long will the fistula remain unhealed. If the urethra is found to be of normal calibre throughout, the case may be left to itself for a week or two and merely watched, in the hope that healing will take place naturally, the patient meanwhile keeping himself quiet. If, after this interval, the fistula has not closed, the patient must be taught to pass the simplest and softest catheter applicable to his particular urethra, and instructed to draw off all his water by catheter; not a drop of urine must be allowed to pass naturally, and, before going to stool, the bladder should invariably be emptied by the instrument. By these means the majority of cases will heal up soundly.

ATROPHY OF THE PROSTATE.—Exhausting disease like phthisis, the wasting of old age, the effects of pressure—notably in old-standing, unrelieved stricture—and diseases such as abscess in the prostate itself, will produce atrophy of that organ. There are no symptoms, and the affection is without clinical importance. A prostate is atrophied if it weighs between two and three drachms.

HYPERTROPHY OF THE PROSTATE.—After middle age the prostate is liable to undergo simple enlargement. This hypertrophy is singular because it is not the result of increased function, as it is in other organs.

such as the heart of the pregnant woman or the arm of the blacksmith; and it is important because of the great influence it frequently has upon the vital function of micturition. See PROSTATIC HYPERTROPHY.

PROSTATIC ULCERATION.—In old-standing urethral stricture, prostatic ulceration doubtless precedes extravasation of urine and prostatic fistulæ. It is not an independent disease, and does not require special treatment.

PROSTATIC 'STRICTURE.'—In the strict pathological sense of the term, prostatic stricture does not exist. Cases are met with occasionally, however, where the hypertrophy has so invaded the urethra that its dilatability is very slight, and the catheter goes so tightly that there is some excuse for speaking of 'stricture at the neck of the bladder.' A dilating olivary bougie or even metal dilator may be passed with caution, and the consequences watched before the operation is repeated; if irritation does not follow, some good may result; but, generally, the safest plan will be to select a catheter sufficiently small to pass with ease.

PROSTATORRHOEA consists of a thin mucopurulent discharge from the urethra, which is not easily distinguished from an ordinary gleet. It frequently supervenes upon a gleet, and occurs amongst those who are morbidly anxious about their sexual organs and who are in bad health. Sometimes the loss of fluid at stool is considerable. The patient always exaggerates the importance and severity of his symptoms.

Treatment.—Fresh air, exercise, tonics, sea-bathing, and liberal diet are chiefly indicated. The surgeon must assure the patient that the complaint is not a serious one, and insist upon his leading a healthy sexual life, which consists in the natural performance of the sexual function, never to be attained outside the pale of matrimony. The passage of a cold steel sound every three or four days may prove beneficial, but the best local application is a solution of nitrate of silver (5 to 10 grs. to f3j.) applied by means of a prostatic injector. A flying blister may often advantageously be kept up in the perineum for an indefinite period. When there is much loss of fluid at stool, it will be diminished if the patient is taught to use a small enema of water before retiring; the process of defæcation is then accomplished with little muscular exertion.

PROSTATIC NEURALGIA.—Men are sometimes met with who, having had many attacks of gonorrhœa or much urethral instrumentation, or being simply highly neurotic, complain of constant aching at

the neck of the bladder and along the urethra. They are free from all apparent disease of the prostate, the stream of urine from first to last is clear of inflammatory product, and there is no calculus or urethral stricture.

Treatment.—All the urinary and sexual functions must be regularly and naturally performed. The general health is to be attended to, and the hepatic system cleared by a few doses of blue-pill. Iron, nuxvomica, bromide of ammonium and, occasionally, belladonna will be found useful. As a rule, no instruments should be passed, but, occasionally, distinct improvement will follow the gentle use of a steel-sound. Perineal blisters may be tried.

TUBERCLE OF THE PROSTATE.—Tubercle rarely invades the prostate; and when it does, some other portion of the genito-urinary apparatus, generally the kidney or testicle, is always similarly affected. The deposit consists of grey miliary bodies in the glandular or stromal tissues; these coalesce, increase, and ultimately form bodies as large as a pea, or even a walnut; sometimes the whole gland becomes invaded. These tuberculous masses may at any time break down into abscess, which will usually burst into the urethra; but may open into the rectum, ischio-rectal fossa, or peritoneal cavity.

Symptoms.—Generally, the patient has frequency of passing water, and pain in the act. The finger introduced into the bowel may or may not detect the deposit, either as one or more isolated masses in the prostate, or as a general enlargement of that organ; for it is only after abscess has occurred, followed by destruction of tissue, cicatrization, and contraction, that the prostate can be said to become smaller when affected by this disease. The urine contains more or less pus, and occasionally a little blood. The patient slowly becomes weaker and thinner. The diagnosis is difficult, and can seldom be made except after considerable careful observation of the patient.

Treatment.—Urethral instruments must be avoided as far as possible. Stress is laid upon this, as these cases are often needlessly sounded for stone over and over again, with much injury. Abscess must be watched for and promptly treated, the patient's general health cared for by attention to diet, exercise, clothing, and climate, with the administration of such tonics as the individual case demands.

PROSTATIC CYSTS.—The prostatic gland follicles may become dilated and form

little cysts. These cavities are frequently found in the hypertrophied prostate. They may contain semi-fluid material or solid calculous matter. Hydatid cysts have not been found in the prostate, but they are not uncommon between the rectum and the bladder, and have been known to occasion complete retention.

PROSTATIC CALCULI.—Calculi may form in the prostate as in other glands, and must not be confounded with renal or vesical calculi, which may have become fixed in the prostatic urethra. They begin as inspissated prostatic secretion, with degenerated epithelium cells from the tubes and acini; irritation is caused, and phosphates are deposited. Several hundreds have been found in a single prostate. They vary in size from a pin's head to a pea; occasionally they grow as large as a chestnut, and a mass, consisting of coalesced calculi, has been removed weighing $3\frac{1}{2}$ ounces. When numerous, they may break through their partitions and collect in a kind of cyst; they then become faceted from constant friction. They consist of phosphate of lime, a trace of carbonate of lime, and animal matter (84.5 p.c.). They are frequently associated with other diseases of the urinary organs—namely, stone in the bladder, hypertrophy of the prostate, and stricture of the urethra.

Symptoms.—Prostatic calculi are often first detected when the patient is treated for stricture or for stone in the bladder. Here, the sound or the bougie conveys a grating sensation as it traverses the prostatic urethra, and, if the finger is introduced into the rectum, the stone may be felt through the prostate. In other cases the concretions may themselves cause local irritation, pain in sitting and moving about, possibly obstruction to the flow of urine, and sometimes even abscess.

Treatment.—The general treatment consists in attention to the health. The bowels and liver should be gently stimulated, and the mineral acids administered in an infusion of *alchemilla arvensis*, *buchu*, or *uva ursi*. The radical treatment consists in their removal by surgical operation. The formation may often be attacked per urethram with a short-beaked lithotrite, or a pair of urethral forceps or a curette; in using the latter two instruments, the calculus should be steadied by the left forefinger in the rectum. If the stone is large, an attempt may be made to seize it with the lithotrite, and push it backwards and upwards into the bladder, where it may be dealt with by lithotrixy. In other cases a

perineal incision must be made. The patient is anæsthetised, and placed in the ordinary lithotomy position. The formation is localised, and its size estimated by the finger in the rectum; a grooved staff is introduced and held in position. Generally a median incision will suffice, beginning about an inch and a half above the anus, and continued downwards for an inch and a quarter. The stone is cut down upon and removed with short forceps. Care must be taken that *all* the stone is removed. The bladder need not be interfered with by this operation, and it is usually a safe and simple one. After the operation, a soft catheter should be passed through the penis into the bladder, tied in, and worn for four or five days. If the stone is considered to be very large, the perineal incision may be made into the urethra upon a grooved staff, as in lateral lithotomy.

CANCER OF THE PROSTATE.—The nomenclature of tumours is in a transition state; according to the most recent classification, tumours of the prostate are divided into four groups: (1) Myoma, or new growth consisting entirely of muscular fibre, a very rare form of tumour; (2) adenoma, or simple hypertrophy, including the encapsuled tumours, *see* PROSTATIC HYPERTROPHY; and the two malignant groups, (3) sarcoma (encephaloid of the older nomenclature), the varieties of which are—(a) round-celled, (b) spindle-celled, (c) lympho-sarcoma; (4) carcinoma (*scirrhus*), the varieties of which are—(a) acinous, (b) tubular, (c) colloid. No case of epithelioma of the prostate is on record.

Under the head of cancer of the prostate we here include sarcoma and carcinoma. The former is much the more common. The prostate may be primarily or secondarily affected by cancer. Fortunately this distressing complaint is rare; it seldom attacks men in the prime of life, but is almost entirely confined to youth and old age.

Symptoms of Cancer.—A diagnosis of cancer must only be made after close watching of the case and careful consideration; for in ordinary hypertrophy there may be much pain, and great size and hardness felt by the rectum, so much so as readily to deceive the inexperienced. Moreover, chronic prostatic abscess, a much more common affection, may, in its earlier stages, and before it has declared itself by fluctuation or discharge of matter, present symptoms remarkably like those of cancer. The chief symptom is pain, more or less constant, described as about the neck of the

bladder, or at the end of the penis, or in the thigh or leg. At first there is frequency and difficulty in making water; generally the patient is more or less dependent upon the catheter. The urine contains, sooner or later, pus and blood. It may be noted here that the urine, in malignant diseases of the bladder, often possesses a peculiarly disagreeable smell, almost but not entirely characteristic to the practised observer. Washing out the bladder constantly, and with powerful disinfectants, may altogether fail to remove the odour. There are usually attacks of hæmorrhage. The patient becomes weaker and thinner, and latterly may have deposits in the glands of the groin, or in those along the course of the iliac vessels. In doubtful cases, the urine should be thoroughly searched by means of the microscope for cancer cells; it must, however, be remembered that the sources of error in such examinations are very numerous.

Treatment.—The patient's powers should be sustained by suitable food, stimulants and medicines; the bladder, if necessary, relieved of retained water by catheter exactly as in the retention from hypertrophy of the prostate, and washed out from time to time with disinfectants. Great care must be taken to ensure an easy daily opening of the bowels by suitable laxatives, such as senna electuary, aloetic preparations, castor-oil, or compound liquorice powder. The diet may be made to aid in this by the daily ingestion of whole-wheat meal bread, oatmeal, raw or cooked apples and other fruits (not too sweet), and green vegetables. The use of the enema, every day or every other day, will often prove of the greatest service. Above all, the patient must be relieved of pain: in many cases the hypodermic injection of morphia, combined with a little atropine, will be best. In others, anodyne suppositories are useful, although the action of suppositories is always more or less uncertain. A suppository should always be applied after the bowels have acted, because a constant source of uncertainty of action is, doubtless, the pushing of the suppository into a mass of feces. In other cases, relief must be obtained by opiates administered by the mouth; they must be selected carefully, and those chosen which are best borne by the individual patient. Many will take laudanum, Battley's solution, or the liq. morphiæ hydrochloratis well; others will do well with the solution of the bimeconate of morphia, and others with the old-fashioned black-drop. Extir-

pation of cancer of the prostate is only mentioned here that it may be condemned. It has been attempted two or three times, and has in each case been followed by the speedy death of the patient. In one instance the peritoneal cavity was found, after death, to have been opened.

G. BUCKSTON BROWNE.

PROSTATIC HYPERTROPHY consists in an increase of the normal elements of the organ. The normal elements are: (1) *stromal*, consisting of involuntary muscular fibre, connective tissue, and elastic tissue; (2) *glandular*, consisting of racemose glands, formed of basement membrane lined with columnar epithelium, and containing secreted matters. The hypertrophy may consist of an equal increase of stromal and glandular structure. This is rare; more usually the stromal are increased far more than the glandular elements. In very rare instances the glandular portion is in excess of the stromal. In addition, there is an interesting and surgically important form of hypertrophy—namely, a growth of both structures, but chiefly of the stromal, in the form of distinct tumours. These tumours are embedded in the body of the gland, or may form nearly separate outgrowths into the bladder. They are rarely found except when general enlargement of the prostate exists. They are the peculiar bodies which occasionally come away entire in the surgeon's forceps, during the performance of perineal lithotomy.

Hypertrophy of the prostate is never found in men under the age of fifty. It usually declares itself between fifty-five and sixty-five. Actual hypertrophy of the prostate exists in about thirty-four per cent. of men at and above sixty years of age, and there are manifest symptoms in about fifteen or sixteen per cent. (Thompson). If a prostate weighs more than seven drachms, it may be said to be hypertrophied. An hypertrophied prostate has been known to weigh ten ounces.

For surgical purposes the prostate may be divided into three parts, two lateral lobes and a posterior middle lobe; these three portions may undergo equal hypertrophy, or any one of them may become more developed than the remaining two. The enlargement of the middle lobe is perhaps the most important, because it interferes more with the performance of micturition than does lateral enlargement. A patient may have marked prostatic enlargement and yet have little or no difficulty in passing water; on the other hand,

he may have great difficulty, and indeed may be unable to make any water except by catheter, and the surgeon may be unable to detect any enlargement per rectum. In such a case the middle lobe is the only part enlarged. Care must always be taken not to confound hypertrophy of the prostate with inflammatory depositions in that organ. Men under fifty are often carelessly spoken of as having enlarged prostates, when really they are suffering from prostatitis, or in rare cases have special pathological formations in the organ.

Causes.—The consequences of the enlarged prostate are so serious that, naturally, all who have studied the subject, from the earliest times, have anxiously inquired why a certain number of elderly men are so afflicted. We are still, however, in the dark, and the truest answer is that we do not know the cause of hypertrophy of the prostate. It may, however, be definitely stated that the disease affects all sorts and conditions of men, and that those of full or gouty habit, especially if they are obliged to lead sedentary lives, are more prone to the complaint than others. It has, indeed, been called 'the judge's disease;' and certainly judges, magistrates, members of parliament, bankers, clerks, shoemakers, weavers, tailors, and coachmen form a large proportion of those afflicted.

Symptoms.—The enlargement of the prostate necessarily interferes with the mechanism of micturition, and the bladder finds difficulty in dealing with any undue accumulation of urine, as after sleep or after the taking of stimulating fluids. This is the explanation of what is usually the first symptom of hypertrophy—namely, that the patient finds, on rising in the morning, that he can only empty his bladder by repeated efforts, and that he is therefore called upon to make water frequently during dressing. Others find that they are disturbed twice or thrice in the night to pass water. Often, there are obscure aches and pains about the neck of the bladder. There may be a little undue straining at stool, with ill-defined but general uneasiness. In rarer cases there may be marked pressure-symptoms, such as pain down one or other great sciatic nerve. The patient may be troubled with erections of the penis; he may also notice that his stream of urine is poor, that it does not commence well, and that when once begun he has to make continued effort to keep it up. If the patient obtains no relief from art, his symptoms gradually increase in severity. Very commonly, he may suddenly be seized with complete retention of

urine; but if this is not the case he gradually fails to empty his bladder, the quantity of habitually retained urine slowly increases, and the calls to pass water become more and more frequent, especially at night; he begins to experience pain when the desire to micturate comes on, which is relieved by passing water, and is therefore unlike the pain of stone. Throughout the progress of the disease the urine may remain clear and acid, but without the intervention of urethral instruments cystitis may come on, and the urine become decomposed and loaded with mucus and the products of decomposition.

Sooner or later the patient begins unconsciously to wet his bed at night. This incontinence is rarely true 'incontinence of urine,' which term means that the bladder cannot hold any water at all. Prostatic enlargement, in very exceptional cases, may so open the neck of the bladder that the organ can only retain a very small quantity of urine; but the surgeon must always suspect a man, over fifty years of age, who complains that he cannot hold his water and that it is always coming from him, of having a bladder full of urine, the apparent incontinence being in reality the overflow from an habitually full or engorged bladder. Too much stress cannot be laid upon this, and surgeons may accept as an axiom that *an involuntary flow of urine indicates retention, not incontinence*. Remembrance of this will save many a patient from death, and many a practitioner from disgrace. At any time hæmorrhage may occur; the bleeding is rarely severe, and often relieves the bladder and prostate considerably. If from ignorance on the part of the patient, or from a mistaken dread of the catheter on the part of either patient or surgeon, a case of prostatic disease, causing the bladder to fail to empty itself, is left untreated by instruments, the progress of the case will be as given below; death being sometimes more speedily brought about by the intervention of a chill, or retention of urine or other disorder, making surgical interference with the urinary organs absolutely imperative at a time when they may prove themselves unable to bear the shock of operation, in consequence of long-standing urinary embarrassment.

At first the bladder undergoes some hypertrophy, and then becomes either simply dilated or sacculated, owing to the great pressure which has to be exerted in order to void urine. By hydrostatic law, this pressure is equally transmitted in all directions, and brought to bear upon every

portion of the bladder-wall. Sacculatation of the bladder results from the mucous membrane being gradually forced outwards between the muscular trabeculae. Sacculi are almost invariably multiform; their walls consist merely of mucous membrane, and, where the bladder is covered by serous membrane, of peritoneum also. In advanced disease, an attack of retention of urine or the application of violence may cause rupture of a sacculus either extra- or intra-peritoneally, with fatal result, especially in the latter instance. Clinically, sacculi of the bladder are interesting, as phosphatic calculi are apt to form in them. Urine never regurgitates from the bladder into the ureters, but, as urine is constantly passing from the kidneys into the ureters, and as they cannot readily convey their contents into the engorged and constantly contracting bladder, they gradually become dilated; the pelvis of the kidney shares in this dilatation, and the renal structure itself becomes diseased from the obstruction met with to the outflow of urine. Interstitial nephritis ensues, followed by abscess (surgical kidney), uræmia, coma, and death.

In all cases of suspected hypertrophy of the prostate, a rectal examination should be made. The patient lies on his back, and the surgeon gently introduces his forefinger. The finger should be familiar with the dimensions of the normal prostate, which is not larger than a chestnut, and can easily be defined above and on each side. Usually, the enlarged prostate will feel as large as a Tangerine orange, sometimes much larger. As before stated, occasionally no enlargement may be felt by rectum, although there is sufficient hypertrophy of the middle lobe to cause complete retention. In certain cases it is proper to ascertain the amount of prostatic growth into the bladder; but this can only be done by the introduction of a short beaked metal sound, and, as instrumentation should always, at the commencement of treatment, be reduced to a minimum, the prudent surgeon will rarely deem it necessary to sound unless symptoms of calculus are also present. When the prostate is examined by a sound, the length of sound introduced before the cavity of the bladder is reached must be noted, and, when the beak has fairly entered, an attempt should be made, by depressing and rotating the handle, to turn the beak to one or other side. If at the same time the finger is passed into the rectum, a very good idea can be formed of the extent of the hypertrophy. It has been asserted that the enlarged prostate grooves the feces as they

pass. This is not the case. Sometimes, owing to great hypertrophy of the prostate, the bladder becomes entirely an abdominal organ, and, when only containing five or six ounces of urine, suprapubic dulness on percussion will be found as high as the navel.

Treatment.—The importance of the treatment of enlarged prostate cannot be over-estimated. If properly treated, life may often be indefinitely prolonged instead of suddenly cut short, and the latter part of it rendered tolerable and useful instead of miserably painful. Moreover, there are few cases more likely to bring the surgeon into sometimes deserved, but far oftener into entirely undeserved, discredit. Thus, a surgeon overlooks a distended bladder, another practitioner passes a catheter and removes a pint or more of urine, to the great advantage of the patient, who naturally draws his own inference; or, on the other hand, from causes explained further on, a case may perish in spite of the most skilful attention after the passage of a catheter.

In the first place, it must be definitely stated that all attempts to diminish the bulk of the enlarged prostate by means of medicines applied locally or by the mouth; or to excise portions of the gland by perineal incisions, or by instruments introduced through the urethra, or to destroy portions by the electric or other cautery, are worse than useless. So also is the injection of iodine into the body of the gland, or the use of bellied sounds to dilate the prostatic urethra. Grave injury may be inflicted by all these attempts to make a radical cure, and although the subject is a very interesting one and has engaged the attention of many good surgeons, there is at present no sound evidence before the profession that any of these plans of treatment are of the smallest use; the practitioner may, therefore, safely dismiss them from his mind, and confine himself to the palliative treatment of the affection.

CATHETERISM.—When a patient, over fifty years of age, without any history of stricture, and unaccustomed to urethral instruments, consults his surgeon about frequency in passing water, and perhaps other painful urinary symptoms, it will be of the first importance to ascertain if he is emptying his bladder. This can only be done by passing a catheter, and, as will be immediately described, catheterism may be followed by important consequences. These consequences will be much less severe, and in many cases may be effectually warded off, if the following precautions are taken.

They should always be taken wherever easily practicable, and invariably if the patient has had urinary symptoms for some time, and if he is elderly, worn-out, and really ill. Other cases may be treated with a little less ceremony, and sometimes necessarily so, since nervous patients may be seriously excited and alarmed if they see that much preparation is required, and they may therefore be tempted to forego the operation and lose the chance that surgery offers them of maintenance of health. In such cases, the surgeon may pass the catheter in his consulting-room, but he will do well to advise his patient to go home immediately afterwards, and, if not very robust, to go to bed and stay there, warm and quiet, for the next twelve or eighteen hours. But if convenient, and certainly if the case appears to be a grave one, an appointment should be made with the patient to meet him in his bedroom at home; the room must be warm, and he should be in his dressing-gown, ready to go to bed if so advised, after the catheter has been introduced.

Before passing a catheter, the patient is desired to make all the water he can by his natural efforts; he must be at his ease, and on no account be hurried. He is then placed with his back to the wall, and the surgeon seats himself in front and passes a perfectly clean, small, soft catheter. A No. 7 E vulcanised india-rubber catheter is less painful to the patient than any other, but sometimes it will not pass readily, and then a soft *coudée* catheter of the same size should be used. (See *Prostatic Retention* under RETENTION OF URINE.) All urine drawn off will be water which the patient could not pass, or 'residual urine.' The patient should keep his room for the rest of the day and take a hot sitz-bath; if the quantity drawn off exceeds three or four ounces, he should go to bed. If the bladder is found empty, and if all is well on the following day, he may be allowed to go about as usual. But if he is found to retain only one or two ounces, the experiment above detailed should be repeated next day, in order to avoid error. A frequent source of error is that the patient, when desired to pass water, fails from nervousness to make his bladder act as fully as it is really capable of doing. If, however, several ounces are found retained, or if the habitual retention of two or three ounces is confirmed by a second inquiry, the patient will have to commence the regular use of the catheter, and will at first need close attention. Should the quantity of retained urine be considerable, say ten to twenty ounces, he must not be

allowed to leave his bed, and will require special treatment, which will be detailed after the fever which may follow catheterism has been described.

FEVER FOLLOWING CATHETERISM (Urinary Fever).—Some men take to the habitual use of the catheter without any constitutional disturbance; but, usually, catheterism is followed by a more or less well-marked febrile attack. This fever comes on independently of abrasion of urethral surface or of any septic contagion; it is frequently confounded with septicæmia, but is quite a distinct fever. It must not be forgotten, however, that septicæmia may follow injury to the urethra, just as it may follow a wound in any other part of the body. The fever now under consideration has unquestionably a neurotic cause, being due to reflex irritation communicated from the urethra to the excretory apparatus of the kidney; it may follow the most skilful and delicate passage of a urethral instrument with every antiseptic precaution, or any kind of surgical or other interference (passage of a renal calculus) with the urinary organs. The kidneys are in a state of shock more or less complete, and more or less temporary. The shock may be so profound that, for a time, there is complete suppression of urine. Practical surgeons have long been satisfied that the fever has a renal origin; the term *urinary fever* is, therefore, more correct than the terms catheter or urethral fever which are sometimes used.

The time that may elapse between catheterism and the onset of urinary fever is very uncertain; fever may come on within a few hours or any time during the first week. It is generally but not always marked at its outset by a rigor, followed by heat and profuse sweating: the temperature varies from 100° to 105° F. The attack may be very transient, or it may be recurrent; but it is usually a continuous fever. The patient feels very low and prostrate, the tongue becomes dry, there is no appetite, but great thirst. This condition may last a week or ten days and pass gradually away, or the patient's state may become rapidly alarming. If the temperature keeps high (108°) and the pulse for some days is over 100, and if the tongue is hard, dry, and furred, the prognosis is unfavourable. Usually, the temperature rapidly comes down, the pulse keeps about 90, and the patient ultimately makes a good recovery and remains thoroughly accustomed to his catheter. In the present state of our knowledge, there is reason to believe that these cases do not end fatally if the kidneys are healthy at the

outset, and if all the precautions about to be described are taken. But if, from long-standing urinary obstruction, the kidneys are diseased, they may not be able to recover themselves, and the patient dies uræmic and comatose.

Unfortunately, the use of the catheter appears to the patient and his friends to be the starting-point of the illness, and surgery, or in other words the catheter, is unjustly blamed; whereas the fatal result is really due to want of the catheter at the proper time. For, if that instrument had been used when the obstructive disease first manifested itself, the renal mischief which actually causes death would have been prevented. We have no means of ascertaining beforehand whether the kidneys are in a state to bear catheterism or not; although, undoubtedly, urine of a low specific gravity is an unfavourable sign. But we need not let this inability impede our practice, for if a catheter is necessary, on account of partial or complete retention, *it must be used*, otherwise the patient's fate is sealed; and if, through long-continued, although perhaps unobserved, disease, he succumb from urinary fever, it is very certain that had he not used the catheter he would have died also, and with much suffering. *See URETHRAL FEVER.*

Treatment at commencement of Habitual Catheterism.—If from the patient's symptoms, and the large area of hypogastric dulness on percussion, there is little doubt that the bladder contains a large quantity of urine (a pint or more), the fever, which is almost absolutely certain, in such a case, to follow catheterism, may be considerably controlled if a small dose of opium, laudanum, or morphia, is administered half an hour before the catheter is first used. In all cases, if there is much constitutional irritability, advantage will follow the administration, two or three times a day, of small doses of morphia. Should rigors occur, spirits must not be administered, but the patient should be wrapped up warmly in bed, hot bottles be put to his feet, and hot tea or other simple drink given to encourage perspiration. From a consideration of the pathology of urinary fever, it follows that, at the commencement of habitual catheterism, all the organs which are complementary in their action to that of the kidney—the lungs, liver, intestines, and notably the skin—should be kept active and in order. This can only be done by confining the patient for at least a fortnight to a warm room, and, if there is fever, to his bed. The diet should consist of bread, vegetables, soup, fish, game, and

chicken, with little if any butcher's meat, and no milk or cheese; spirits must, as a rule, be avoided, and as little wine given as the patient's previous habits will allow. The bowels and liver must be kept gently acting by some laxative medicine, combined with small doses of blue pill. Irritation and soreness of the parts must be met by hot baths.

Above all, the patient must be able to obtain relief by the catheter whenever necessary. As the secretion of urine varies in quantity from time to time during the twenty-four hours, he should not be dependent upon the periodical visits of his surgeon for relief by the catheter, but should learn to pass it himself or have a skilful attendant always at hand. If the quantity retained is about three ounces, the catheter must be passed morning and evening. If the quantity is more than three and less than six ounces, the instrument must be used three times in twenty-four hours; if the amount is much over six ounces, it will be required four times a day. Should no water be made naturally, the catheter must be used whenever the desire to micturate comes on. Patients often try to postpone the use of the catheter as long as possible, and look upon the instrument as a source of irritation. This is not the case, and it is better for them to pass the catheter even oftener than is really necessary than too seldom.

Special Care after Complete Retention. For the instrumental relief of retention from enlarged prostate, *see* RETENTION OF URINE.

All the details above enumerated as necessary when catheterism is commenced, are here more than ordinarily called for. If the patient prove to be one of the very few who, after such an attack, do not require to commence regular catheterism, because he recovers with complete control over his bladder, he should keep his bed for twenty-four hours, and his house for two or three days, and take a little calomel or blue-pill with some colocynth or rhubarb. If, on the other hand, as is almost sure to be the case, the regular use of the catheter is required, the patient should be kept in bed until the fever, which is to be expected within the first five or six days, has passed away. A catheter should not be tied in unless, owing to irregularity of the canal or false passages, constant catheterism is very difficult. A silver catheter should never be retained. If the amount of retention has been great, say 30 to 40 ounces, the bladder should not be emptied at the

first catheterism, but about 20 ounces be drawn off. Death from syncope has been known to follow the sudden emptying of a bladder under these circumstances, and, in all cases, such a proceeding increases the shock to the system, causes pain, and may provoke dangerous cystitis. Generally, it is wise to let four or five days pass before the bladder is entirely emptied. Early in the progress of such a case there may be a good deal of hæmorrhage into the bladder.

After complete prostatic retention, it is improbable, although not impossible, that the patient will recover the power of emptying his bladder. He may be fortunate enough to regain his power completely; but this is very rare, and if he regains power at all, it is more likely to be partial only. In any case, he should learn to pass a catheter without delay, either in order to use it habitually, or when seized with retention, which is very likely to recur. Patients are often most anxious to be treated for want of bladder power, but reliance must not be placed on drugs, although a little strychnia may be given. The general health and nutrition must be carefully attended to, and the bladder allowed all the relief from the catheter it requires. The catheter is a good friend to an atonied bladder, and its use allows the bladder any chance it has of recovering its tonicity, although the very reverse of this is often considered to be the case.

General Treatment of the Enlarged Prostate.—Cases of prostatic hypertrophy are not infrequently met with, where there is no habitual complete or incomplete retention of urine, but where the patient is subject to sudden attacks of what he calls 'stoppage of his water.' These are brought about in three ways: first, by the influence of strong emotion or excitement, as great or prolonged mental effort, anger, fear, or grief, which appear to withdraw nervous energy from an organ already in need of all it can possess, and bring about entire inability on its part for a time to expel its contents. Secondly, by mechanical closure of the prostatic urethra and neck of the bladder due to congestion, which may be caused by exposure to cold, constipation, venereal excitement, and prolonged sittings (railway journeys in the sitting posture, particularly if occupying many hours, and if the weather is cold, are very likely to bring on retention in these cases). Thirdly, by any cause which fills the bladder with more urine than it is able to cope with, diuretic medicines, excess of alcoholic or

other stimulating drinks, or failure on the part of the patient to give his bladder an opportunity of relief when it first demands it. The advice to be given to these patients is obvious: they must avoid mental excitement, exposure to cold, much stimulant, long railway journeys, and so on. Above all, they must be taught to use a simple catheter, so that, whenever and wherever seized with retention, they may be able at once easily and safely to relieve themselves.

The majority of sufferers from enlarged prostate, however, sooner or later require regular catheterism, and should be invariably taught to perform it for themselves. The best instrument for habitual use, undoubtedly, is the soft French *coudée* catheter (No. 7, E.); the end is permanently turned up, and in consequence avoids the irregularities of the floor of the prostatic urethra and passes easily into the bladder. Some patients prefer the vulcanised india-rubber catheter; but its interior is small and its walls are thick, and contact with oil causes it to swell and destroys its polished surface. The olivary catheter is rarely desirable when the prostate is enlarged, but the English gum catheter is not infrequently superior to all others. As a rule, silver catheters should not be used. Sometimes the most careful manipulation of the catheter will fail to empty the bladder. When this is the case, there is probably some sacculation of the bladder, or dilatation of the ureters, or large inter-ureteral ridge. The patient is to be advised not to keep pushing his catheter in and out, in search of a little more urine, beyond a minute or so, but to trust to washing out the bladder at stated times to keep it free from decomposing urine. Much manipulation of the catheter is very likely to cause orchitis.

Catheters must be kept scrupulously clean; they should be syringed through every now and then with a solution of carbolic acid (1 in 500). The best lubricant is fresh olive oil; if desired, a little carbolic acid may be added (1 in 40). Some prefer castor oil and others vaseline. It will add much to the patient's comfort if he is directed to draw back the foreskin once or twice a day and wash with soap and water, to dry the part thoroughly, and apply a little simple dusting powder with a puff before readjustment. Neglect of this precaution may result in inflammation, soreness and itching, from the constant manipulation and contact with urine and oil.

The diet should be light and unstimulating; food should be selected which tends to keep the bowels easily opened, such as vegetables, apples, and brown bread. The less stimulants are used the better. Exercise should be taken regularly. When once the catheter has been mastered, there is no reason why the patient should not resume his usual activity, and ride or even hunt. He should also return to his usual pursuits and the ordinary duties of society; examples are numerous of men, occupying active and responsible positions, who have practised catheterism fifteen, twenty, and even thirty years, and finally have died of complaints in no way connected with their urinary organs.

The whole of the medicinal treatment of the enlarged prostate consists in keeping the bowels gently opened. Patients instinctively discover that they are never so comfortable as when the bowels act easily. An enema is useful, and mild laxatives, such as senna electuary, castor oil, aloetic oil, or compound liquorice powder, may, if necessary, be taken habitually.

The skin should be kept in constant motion by means of hot water and soap applied once or twice a week, and daily rubbing with a stout flesh-brush. There is no real need for patients to seek a warm climate during the winter months, if they are careful to be warmly clothed from neck to heel in flannel underclothing. Exposure to cold need not be avoided if extra clothes are worn. Great risk is often run by wearing evening dress; if this cannot be avoided, a deficiency of external clothing must be made up by additional underclothes.

Washing out the Bladder.—In prostatic disease it is often necessary to wash the bladder out. The mucous membrane may require astringent applications, or the urine may be sacculated, and the catheter may be insufficient to entirely evacuate the bladder, which, if left behind habitually, deposits and deposits the triple phosphate of ammonia, lime, and magnesia; in such cases irrigation with disinfectant washes is indicated for.

The best apparatus to use is an india-rubber four-ounce injecting bottle, with a stopcock, or a Higginson's syringe apparatus fitted with a two-way tap, specially arranged by the writer, and known as his bladder-irrigator. In these instruments, the hand regulates the quantity of fluid and the force with which it is ejected. Many forms of apparatus have been devised, chiefly on the principle of the syphon, which, among other reasons, are

objectionable because the force with which the injection is made cannot be nicely regulated. No air must be allowed to enter the bladder, and not more than two or three ounces of warm fluid (100° F.) injected at a time, although that quantity may be thrown in over and over again if deemed necessary. For cleansing the bladder, a solution of carbolic acid (gr. $\frac{1}{2}$ to f3j.) is useful, or boracic acid (f3j. of the saturated solution to f3j.) may be used. Other disinfectants which may be tried are perchloride of mercury (gr. $\frac{1}{2}$ to f3j.), liquor pot. permanganatis (℥xij. to f3j.), Barff's boro-glyceride (℥xij. to f3j.), and also thymol and sanitas. A good soothing wash is composed of f3ss. of glycerine and gr. xv. of borax to each ounce of injection. Nitrate of silver (gr. $\frac{1}{4}$ or $\frac{1}{2}$ or $\frac{3}{4}$ to f3j.) often acts remarkably well on the inflamed vesical mucous membrane. The mildest solution just named should always be used at first; if well borne by the patient, the injection may gradually be made a little stronger. Acetate of lead (gr. j. to f3j.) makes a good injection, especially when there is cystitis with a tendency to deposition of phosphatic crystals. The glycerine of tannin (℥iv. to f3j.) or tincture of steel (℥v. to f3j.) make good astringent washes, and quinine (gr. j. to f3j.) has been much used as a germicide. Dilute nitric acid (℥j.-ij. to f3j.) and dilute phosphoric acid (℥ij.-iv. to f3j.) are recommended when there is a tendency to alkaline deposits.

Phosphatic deposits can here be barely alluded to. When small, they may be washed out through large catheters; when larger, they come within the province of the lithotritist. If a patient has pain after he has used his catheter, blood and mucus in his water, and pain when driving, a stone behind his enlarged prostate should always be suspected.

Treatment of Advanced Prostatic Disease when Life is in Danger from exhaustingly frequent Catheterism.—Cases of habitual catheterism are exceptionally met with where, as age advances, the bladder becomes intolerant of urine, and the patient is gradually driven to pass his catheter more frequently, until at last he lives only to do so, hourly or even oftener. This continual exertion, night and day, rapidly exhausts an elderly man, and, unless relieved, he dies miserably. The circumstances of the case make the presence of a stone in the bladder not unlikely, and the patient should first of all be carefully sounded. If no stone is found, and the case permit of a little delay, opiates may be

tried, with rest and hot bathing. A soft catheter may be tied in, but it rarely does any good, and often adds to the patient's sufferings. If, on the other hand, the necessity for relief is urgent, and if morphia in its various forms is not tolerated or fails to give substantial relief, the bladder must be opened and drained, and not allowed to act as a reservoir for a time, but only as a channel. Suprapubic incision into the bladder has been tried and found wanting, and there are grave objections to rectal tapping and subsequent drainage, to perineal cystotomy, and to tapping the bladder with trocar and canula through the perineum without incision—an old method recently revived.

The safest and best means of drainage is obtained by the old operation, called by the French '*la boutonnière périnéale*.' The patient is anæsthetised, a grooved staff is passed into the bladder, and he is tied up in the lithotomy position. An incision, an inch long, is made through the skin in the median line of the perineum, ending within three quarters of an inch of the anus. The operator's left forefinger in the rectum distinguishes the apex of the prostate and the groove in the staff. A narrow, straight, sharp-pointed bistoury is introduced at the lower part of the wound, back downwards, and carried in front of the rectum to the membranous urethra, which is opened upon the staff, care being taken not to wound the bulb. A narrow blunt gorget is passed along the staff into the bladder, the staff is withdrawn, and the right forefinger (the left is reserved for the rectum) passes along the gorget into the bladder and explores its cavity; if nothing abnormal, except an enlarged prostate, is found, an india-rubber tube is passed through the wound into the bladder, by means of which drainage is effected for ten to fourteen days. The tube may then be permanently removed. The wound soon heals, the patient returns to the use of his catheter, and finds that the intervals between the catheterisations are considerable, and that life is again tolerable.

HÆMORRHAGE FROM THE HYPERTROPHIED PROSTATE.—During the first two or three weeks of entire dependence upon the catheter, the urine may suddenly be found to contain much blood. The bleeding is probably from the walls of the bladder, and is due to the withdrawal from them of the pressure of retained urine. Patients, also, who are accustomed to the catheter may occasionally pass much blood; they have had difficulty in passing the instrument, or

familiarity has somewhat bred contempt and they have been rough or careless; the hæmorrhage here is from the prostate. In advanced prostatic hypertrophy the vein about the prostate become enlarged, and bleed freely when injured. 'Vesical hæmorrhoids' are sometimes spoken of; but a condition deserving such an appellation is extremely rare. Whether the blood is from the prostate or bladder, the appearance of the urine is the same: it is intimately mixed with blood, and, when it issues from the urethra, the beginning of the stream is as bloody as the end. The blood is of a peculiar rich purple colour, and, looked at in bulk, is almost black. The patient and his friends are seriously alarmed, but with careful management he usually recovers.

It may be well to mention here that, in hæmorrhage from a tumour of the bladder, the stream of urine as it issues from the penis is usually more bloody at the beginning, or at the finish, than it is in the middle of its flow; it is generally most bloody at the finish. There is also pain with a tumour of the bladder, specially at the end of making water; this is not so in the cases now under consideration. The urine may be very full of blood in cases of stone in the bladder, but only after the patient has taken an unaccustomed amount of exercise.

Treatment.—Absolute rest in the lying posture in bed must be ordered and enforced. The urine must be drawn by a soft, easy-going catheter, passed with care and skill. Metal catheters should not be used. From injury to the urethra, the catheter can only be introduced with difficulty, it may be tied in and plugged; when the patient wishes to relieve his bladder, he does not rise from his bed, but simply turns over on his side and withdraws the plug. The bladder should not be washed out. Clots of blood in the bladder may safely be left to the disintegrating action of the urine; they gradually break up and come away. Should clot, however, get into the eye of the catheter and interfere with its action, a little cold water may be injected through the instrument and the clot washed back into the bladder. If, as sometimes happens, clots cause much difficulty, the catheter may be fitted with an English gum bougie just large enough to fill the interior; when introduced into the bladder, the bougie is withdrawn, and usually urine flows freely. In one case of the writer's, he and the patient were worn out by incessant trouble from difficult catheterism and the constancy

locking up of the catheter by clot. Morphia was administered freely, and under its influence the bladder was allowed to fill with blood and urine. In twelve hours the catheter was used cautiously. The patient was still kept under the influence of morphia, and the catheter used every six hours. At the end of forty-eight hours the urine came away almost clear, with quantities of broken-down blood-clot, and the patient made a good recovery.

Ice may be applied above the pubes or placed in the rectum, but it is of questionable service. An iced infusion of matico has been injected into the bladder, and in certain cases is worthy of trial. Styptics may be administered by the mouth: gallic acid, tannic acid, alum, iron alum, sulphate of iron, tincture of steel, red gum, hamamelis, Spasmodic's styptic and ergot are those generally used, but the writer has no confidence in these remedies. He considers opium, or some preparation of opium, the only medicine likely to be of service by the mouth. The system must be supported by light, nutritious foods; hot drinks should not be taken, and alcoholic stimulants are to be avoided unless the patient is much exhausted. G. BUCKSTON BROWNE.

PRURIGO is a chronic inflammatory disease of the skin, characterised by the formation of pale, discrete papules, accompanied by intense itching.

Cause.—Numerous theories have been advanced to account for the presence of prurigo, but none are satisfactory. Although it may be accompanied by diathetic conditions—scrofula, rachitis, &c., or by albuminuria, yet no one of these has been proved to be its cause. It is at present rather regarded as a disease of the skin itself. Prurigo, though a rare disease, is comparatively common in Austria, where it was first described, but less common in other countries; it is found most frequently amongst the poor, ill-cared-for classes. Though not confined to the genital, it makes its appearance very early in life (during infancy), at which period it is evidenced rather by the formation of wheals than of the peculiar papules now to be described. The disease is worse in winter than in summer, and generally persists during a lifetime.

Pathology.—There are two theories as to the pathology of prurigo. (1) That it is a neurosis, giving rise to a tetanic contraction of the arrectores pilorum, thus causing a papulation analogous to cutis anserina. (2) That it is inflammatory in origin. A considerable number of observations have

been made upon the prurigo papule, and there is pretty general agreement that the microscopic appearances are not peculiar, but such as may be encountered in any cutaneous inflammation—that is to say, there is cell-infiltration, especially in the papillary body, together with later changes in the epidermis, notably the exudation of fluid in the form of an abortive vesicle. It is this late formation of fluid which is said to give rise to the itching by irritation of the nerve-endings, the itching being always secondary to the papulation. What originates the inflammatory papules is not known. All other objective symptoms of prurigo are due to the mechanical irritation of the skin by scratching.

Symptoms.—The papules which are peculiar to the disease are often recognised with difficulty, as they are but slightly raised, and may be only perceptible to touch. In colour they may be pale red, but more often they take the hue of the surrounding skin; they are mostly of the size of hemp-seeds, and are not closely placed, but disseminated. The intense itching and consequent scratching which they give rise to soon modifies their appearance; their summits become abraded by the finger-nails, and ultimately topped with a minute blood or serum crust. Again, the scratching gives rise to the formation of other secondary blood-crusts, such as are common to all itching skin-affections. A picture made up of these disseminated blood-crusts, affecting especially the outsides and extensor surfaces of the limbs, the trunk to a less extent, and possibly the cheeks and lower jaw, together with a dusky, harsh, ill-nourished skin, is the one which is most often encountered in this country as the representative of prurigo (*prurigo mitis*).

In severer types of the disease (*Hebra's prurigo*, *prurigo ferox*), in consequence of the chronic inflammation the skin becomes deeply pigmented, the natural furrows deepened and exaggerated, especially in the neighbourhood of joints; finally, thickened and resisting to the touch, so that a fold is pinched up with difficulty. On passing the hand over the affected skin, say of the leg, it feels wooden and rough, like a coarse nutmeg-grater; this roughness is conferred by the broken wiry hairs which cover the part. The limbs are always the parts most affected, and of these the extensor surfaces. The flexures and scalp are very rarely attacked; the palms and soles, penis and scrotum, never. Prurigo of any grade, but especially the severer type, is liable to be complicated by linear excoriations, ecthymatous lesions,

and local impetiginous eczemas of varying extent and degree.

Diagnosis — from Scabies.— The long chronic history, the absence of burrows or lesions on the palms, soles, or penis; the absence of the eruption from the axillæ and insides of thighs, the presence of the eruption on the face, are the most important points. *From Phthiriasis or Pediculosis.*— The presence of the eruption about the hands; its characteristic localisation on the extensor surfaces rather than in the positions where the clothing fits tightly—e.g. the shoulders and waistband, as in phthiriasis; the absence of pediculi or nits about the clothing, which are rarely absent in old-standing phthiriasis. *From Eczema.*— Chronic eczema tends to affect the flexures; the scalp, penis, and scrotum are also liable to be the seat of the disease. Anatomically, eczema is characterised by closely set papules turning into vesicles. Many cases of prurigo are, however, complicated with eczema, only revealing their nature on the latter affection being cured. Prurigo must not be confounded with pruritus.

Treatment.— Tonics may be given if required—iron, arsenic, cod-liver oil. But only external remedies will give relief for any time; of these, soft-soap, sulphur, and tar are the best.

The uppermost layers of the cuticle should be removed by soft-soap baths, their use being alternated by the inunction of some bland oil (olive or almond). Then, after the irritation produced by the soft-soap has subsided, the patient should have the affected parts painted with juniper tar (ol. cadinum or *huile de cade*), and immediately afterwards he is to remain in a warm bath from three to six hours. Such treatment will mitigate the disease, and may be undertaken from time to time; but permanent benefit is not to be expected. Any complicating eczema should be controlled before the above treatment is undertaken.

A. SANGSTER.

PRURITUS. See PRURIGO.

PRURITUS ANI.—A sensation of itching on the cutaneous surface surrounding the anus. It is frequently most distressing, and local examination should always be made, as it sometimes depends on easily removable causes. The effects of scratching, which the itching induces, must not be mistaken for the cause. It is sometimes due to pediculi pubis which have, unknown to the patient, settled there. External piles and inattention to cleanli-

ness will also induce it. In fat subjects, chafing of the nates and retention of the secretion of the anal glands may cause it. Oxyurides in the rectum, or a chronic mucous or purulent discharge from the rectum, due to catarrh or piles, prolapse, polypus, or stricture, may be the exciting cause. Venous congestion of the part, from obstruction of the portal or systemic circulation or chronic constipation, may lead to malnutrition of the tissues, which may be expressed by local irritation similar to that experienced by patients with varicose veins of the lower extremities. This variety may be exacerbated by indulgence in alcoholic stimulants or by highly seasoned food. It is sometimes a symptom of gout. Occasionally, no cause can be discovered.

The *treatment* consists in the removal or alleviation of the exciting cause if it can be discovered. For pediculi, a lotion of corrosive sublimate four grains, rectified spirit two drachms, and water to an ounce will suffice. Oxyurides may be removed by injections of salt and water, with scammony and calomel pills. External piles should be cut off. Attention to diet and purgation will relieve local congestion. Perfect cleanliness is essential. Eczema will usually yield to some mild stimulating ointment, such as nitrate of mercury ointment, diluted with two parts of vaseline. When the itching has continued for some length of time, the skin will be found to be seamed with cicatrices produced by scratching, and the subcutaneous tissue will be converted into an unyielding mass by infiltration with leucocytes and chronic inflammatory exudation. In this condition, painting the surface with acetic acid—so that the acid shall not touch the margin of the anus—and the subsequent application of petroleum ointment, will be found very beneficial. This affection is especially intractable when the exciting cause cannot be ascertained. It is then probably due to some disordered condition of the constituents of the central nervous system. Internal administration of bromide and iodide of potassium may be advantageously combined with local applications. When the irritation is the result of catarrhal discharge, the exciting cause must be suitably treated. JEREMIAH MCCARTHY.

PSAMMOMA. See SARCOMA.

PSEUDO-HYPERTROPHIC MUSCULAR PARALYSIS.—Pseudo-hypertrophic paralysis is a progressive disease, characterised by weakness of many muscles, some of which are usually at first enlarged

and others wasted. The change in the muscles consists in an interstitial growth of fibrous and fatty tissue. Ultimately contractures occur, causing deformities. The affection usually commences in childhood, develops with growth, and after the symptoms have existed for ten or fifteen years, death occurs in consequence of secondary results of the weakness of the respiratory muscles.

The chief features of the malady were described in 1861 by Duchenne, who gave it the name by which it is now known, based on the muscular enlargement, which is, however, a variable and inconstant feature. A well-marked group of cases had been studied and described by Meryon in 1852, and isolated examples had been before published, the first by Sir Charles Bell in 1830.

Etiology.—Males are more prone to suffer than females, in the proportion of 1 to 1. The disease is often hereditary, and cases may occur through several generations. It is almost always inherited through the mother, who does not herself suffer from it. A woman's sons by different husbands may be affected. In other instances, several brothers and sisters may suffer, although in antecedent cases can be traced. Eight brothers have been known to suffer without any ancestral cases. The disease must, then, be due to a congenital tendency, although it is not actually inherited. In other cases, which constitute about half the total number, the disease is isolated, no other instance being traceable in the family. No hereditary relation to other diseases can be traced. The affection always commences during the period of development, and usually when muscular development is most active—in early childhood. In a few instances, symptoms have not been noticed until early adult life; but the disease always long precedes its symptoms, and in such cases there is often a history of large muscles since childhood, although there was no obtrusive weakness during youth. No immediate causes can be traced. Some morbid influences, such as acute diseases, have preceded the first symptoms, but have merely served, by their depressing action, to bring out the indications of the pre-existing malady.

Pathological Anatomy.—The affected muscles, whether large or small, are firmer than normal, unless the enlargement is considerable, and then they may be soft. On section they are yellowish in colour, and the much enlarged may resemble perfectly fatty tumour, no red tint being perceptible. The microscope shows that the resemblance

is more than one of appearance. The chief part of the bulk of the enlarged muscle consists of fat-holding cells, with fibrous tissue between them, identical in structure with ordinary adipose tissue. Here and there among the fat are bundles of muscular fibres, most of which are unduly narrow, although otherwise normal in aspect. Some, however, present signs of degeneration, and there are many empty sarcolemma sheaths, showing where fibres have perished. In the muscles that are small there is little fat; the fibrous tissue is increased, and the muscular fibres are narrow and in process of destruction. No other organ constantly presents changes. The spinal cord may be perfectly healthy; in some cases slight alterations have been found in it, but these have varied much in seat and character, and are certainly of secondary origin.

Symptoms.—These are of two kinds—the weakness of certain muscles, and the change in their size—both being the result of the morbid process just described. The increase in size, in rare cases, affects almost all the muscles of the trunk and limbs; usually it affects only a few muscles. Those almost constantly enlarged are the calf muscles and the *infraspinati*; next in frequency are the extensors of the thigh, *glutei*, erectors of the spine, *deltoid*, and *triceps*; much less frequently the *biceps* and the forearm muscles; very rarely the *masseters* are enlarged. The muscles almost always wasted are those that depress the raised arm—the *latissimus dorsi* and the lower part of the *pectoralis major*; they may even seem absent. The upper arm muscles may also be small instead of large. The extensors of the knee are frequently lessened in size. Sometimes, the *rectus* is small and the *vasti* abnormally large. Before definite muscular weakness is observed, often soon after a child learns to walk, a certain clumsiness of movement attracts attention; he readily falls, and runs with difficulty, and with a waddling gait.

The definite loss of power, which slowly comes on, affects, first and chiefly, the extensors and flexors of the hip and the extensors of the knee, and causes a characteristic defect of movement. There is a difficulty in going upstairs and in rising from the floor. If the child cannot take hold of furniture to help him up, he puts his hands on his knees, and so helps their extension by transferring part of the weight of the trunk from the upper to the lower end of the femur, close to the fulcrum of the lever which this bone then constitutes, and the part of the body in front of the

centre of gravity serves to aid instead of opposing the extension of the knee. If the extension of the hip is feeble, this movement is aided by grasping the thighs and moving the hands alternately higher and higher, and so, as it were, pushing the trunk up by 'climbing up the thighs.' Sometimes the extension of the knees is effected by getting on 'all fours,' and, when the child is resting on the toes and hands, the latter are transferred to the knees, first one and then the other, and the erection completed as above described. Lordosis is very constant, the lumbar spine being curved (convexity forwards) so as to cause a considerable hollow in the back, and the shoulders are carried backwards to compensate and maintain equilibrium. The lordosis is not the result of any weakness of the trunk muscles, but of that of the extensors of the hips, which causes the pelvis to be tilted forwards. When the patient sits, and the pelvis becomes horizontal, the lordosis disappears at once. Sensation, cutaneous reflex action, and the sphincters are all normal. The knee-jerk, however, is lessened, and ultimately lost. Slight contracture comes on in the muscles of the calf, so that the foot cannot be flexed beyond a right angle. There is, for a long time, little impairment of power in the arms. The mind is unaffected as a rule, although the disease has occurred in association with idiocy.

The loss of power slowly increases, until the patient becomes unable to mount a single step or to rise from the floor without help. He can still walk on level ground, swaying the body so as to throw its weight on to the leg that is on the ground. The contraction in the calf muscles increases until definite talipes equinus results, and at last prevents walking. When this occurs, the deformity rapidly develops, the foot becomes inverted, and the equino-varus extremely marked. The hamstrings also undergo contraction, and, in the sitting posture, the unequal weakness of the spinal muscles leads to lateral curvature. The arms gradually lose power, chiefly in the muscles of the shoulder and elbow; the hands remaining useful to the last. As the disease progresses the muscles waste, the fat becomes absorbed, the muscular fibres perish, and the fibrous tissue contracts. There is at first no change in their electric irritability; but, as the disease progresses, this irritability lessens slightly to both currents. Death results in most cases from chronic broncho-pneumonia, the result of the weakness of the respiratory muscles, or from some pulmonary or laryngeal inflam-

mation which that weakness renders serious. The course of the disease varies much in rapidity, and, as a rule, is shorter the earlier the symptoms begin. If it commences in early childhood, power of rising from the floor is lost at about eight, that of standing at ten or twelve, and death occurs between fourteen and eighteen. If the first symptoms are delayed till six or eight, the power of walking may not be lost till fourteen or fifteen, and life may be prolonged until twenty or twenty-two. In rare cases, failure of power does not occur until the end of the second decade, although enlargement of muscles has existed since childhood. In these cases the progress of the disease is slow, and may even cease.

The enlargement of the muscles, although a common and obtrusive characteristic, is not an essential feature of the disease. It depends on the growth of fat in the interstitial fibrous tissue: the latter may form alone, and all the muscles may be lessened in size, although firmer than normal.

Pathology.—The balance of evidence is strongly opposed to the idea that the disease is primarily one of the nervous system. Its origin, course, and character all suggest that it is a developmental disease of the muscles, the expression and result of a morbid tendency of growth, a vice of the germinal material, by which there occurs an undue development of the interstitial tissue, before which the muscular fibres waste. The weakness is due to the interference with the latter, and is thus a secondary effect of the overgrowth. The muscular fibres, moreover, seem to suffer less when there is a deposit of fat in the interstitial tissue than when this consists only in a fibrous overgrowth. The only symptom that might suggest a doubt as to the purely muscular nature of the disease is the loss of the knee-jerk; but that difficulty disappears if we regard this phenomenon—as the writer believes we must regard it—as the expression of a muscle-reflex irritability which may well be impaired by a muscular disease.

Diagnosis.—The diagnosis rests on the peculiar impairment of motor power, coupled with the enlargement of some, and the wasting of other, muscles. The enlargement of the calf muscles, with a contracture that cannot be overcome, the enlargement of the infraspinati, and the wasting of the depressors of the arm, the swaying walk and waddling run, the mode of rising from the floor, the lordosis, and the diminished knee-jerk, make up a characteristic group of symptoms. The chief diagnostic difficulty is the distinction from

ases of slight congenital spastic paraplegia, in which the muscles of the legs are large and firm, there is contracture of the calves, and the gait may resemble that of pseudo-hypertrophic paralysis. But attention to the following characteristics of these cases will always prevent error: The knee-jerk is excessive; there is a tendency to rigidity in the legs; the contracture of the calf muscles is active, and can be overcome by steady pressure applied to the soles; there is no wasting of the depressors of the arm; there is often slight inco-ordination of the hands; and the tendency of the disease is to lessen instead of to increase.

Prognosis.—Of a disease that consists in a morbid tendency to tissue-development, growing with the growth of the sufferer, and a little open to influence as is increase in stature, the prognosis is of necessity most grave. All that can be said is that, after the disease commences, the slower its advance is likely to be; and when growth is over and adult life is reached, its progress may almost or even altogether cease.

Treatment.—No treatment has a distinct influence on the morbid process that underlies the symptoms. In no instance has its course been arrested. Arsenic seems, in some cases, to hinder for a time the increasing weakness, but frequently it has not even an apparent influence. The same may be said of cod-liver oil. The tendency to the accumulation of fat in the muscles does not contra-indicate cod-liver oil, since the muscular fibres seem to suffer less when there is fat than when there is simple fibrous tissue. Faradisation may be employed to aid the nutrition of the muscular fibres, but its influence is small compared with that of the normal physiological stimulus to muscular nutrition—muscular exercise. Systematic movements, so arranged as to call into action the muscles that are weak, are of great importance. They should not be hurried to the point of fatigue, but should be frequently repeated. Walking should be persevered in, and a low step arranged, a few inches high, on which the patient may step first with one leg and then the other, and the height of the step may be gradually increased. Systematic rubbing of the muscles is also desirable, and passive movements may be employed to prevent or lessen the contractures, when these are threatened. It is of great importance to hinder the contraction of the calf muscles, and keep the patient as long as possible on his feet. If considerable contraction has occurred, tenotomy is necessary. The writer is known the operation to restore for

several years the lost power of walking. It is important that the tenotomy should be performed promptly when the necessity for it has arisen, before the muscles suffer further from disuse. In the later stages of the malady, the danger of pulmonary disease must be remembered, and its exciting causes as far as possible avoided.

W. R. GOWERS.

PSOAS ABSCESS.—An abscess occupying the sheath of the psoas or of the psoas and iliacus muscles, eventually and generally spreading beyond these limits.

Cause.—When the abscess is chronic, the usual cause is caries of the vertebræ from which the psoas muscle arises, or, more frequently, disease of the dorsal vertebræ; also sacro-iliac disease. Occasionally there is no cause assignable: the superficial erosion of the vertebræ found in these cases at the autopsy, and regarded as a consequence of the suppuration, the writer believes to be the cause. Acute psoas abscess in adults is rare, but has been seen following rupture of the muscular fibres from strain; one proved fatal in two weeks from pyæmia (Marshall). Acute idiopathic psoas abscess is seen occasionally in children.

Pathology and Course.—Caries of the lumbar vertebræ gives rise to suppuration beneath the origin of the psoas, and, following the line of least resistance and of gravity, the pus passes down the whole length of the muscle, destroying its fibres, and, when spreading (in ilio-psoas abscess) into the iliac fossa, converts the iliacus also into a sac of matter. When due to caries of the dorsal vertebræ, the pus enters the sheath of the psoas beneath the *ligamentum arcuatum internum* of the diaphragm. The abscess is more or less multilocular, especially in the psoas portion: it may be single or double. At first it is of the shape of the psoas, then it expands considerably, either from the iliacus becoming involved, or from the pus extending beyond the limits of the muscle-sheath.

When following an anatomical course, the matter leaves the abdomen under Poupart's ligament behind the vessels, and passes inwards to the adductor region. If the iliac portion passes out separately or distinctly, it forms a swelling external to the artery. Where the amount of matter is large, its relationship to the artery varies: sometimes it quite conceals it, and sometimes pushes it against the skin so that it beats subcutaneously. Once in Scarpa's triangle, the abscess forms its own sac,

and then varies very much in character. Generally it is globular, and presents in the adductor region; but, in addition or independently, it may turn outwards under the tensor vaginae femoris and open over the great trochanter. When large, it may appear double from an oblique depression on it caused by the sartorius; when small, it may simulate a femoral hernia as a small tumour at the ring, having an impulse on the patient coughing, or as a sausage-shaped swelling parallel to Poupart's ligament. It has been known to simulate inguinal hernia by travelling down the canal (Shaw).

Psoas abscess may protrude from the abdomen in other places: thus, posteriorly above the iliac crest, forming a lumbar abscess, or, turning downwards, become gluteal. It may pass through the sciatic foramen and descend the back of the thigh and even reach the leg, or following the curve of the sacrum it may present in the perineum. The extra-abdominal part may be of any size up to that of a sac holding pints; at times it causes great œdema of the leg from pressure. From the proximity of the sacro-iliac joint to the psoas muscle, and of the hip to the conjoined psoas and iliacus, secondary suppurative disorganisation of these joints may at times be seen—that of the hip being always a fatal complication.

Psoas abscess points usually in the upper adductor region; occasionally just above Poupart's ligament or over the trochanter. It may open in various parts of the back of the thigh: into a viscus (bowel or bladder) or into large arteries, aorta (Savory), iliac artery (Ashurst). It may never point, gradually receding and vanishing by caseation and absorption, and that when of large size. When double, one abscess only usually reaches the thigh. When it bursts of its own accord, it does so through a minute opening: a gush of seropus flows, and the opening soon gets blocked with flocculi; after a time these are displaced and more fluid escapes. Owing to the gradual evacuation and the protection against admission of air, the discharge is frequently quite unattended with constitutional disturbance. When quickly evacuated, inflammation of the sac follows, and pyrexia or septicæmia is usual.

Symptoms.—There may be none; old unsuspected psoas abscess being often found at the autopsy (Bryant). Early symptoms depend upon irritation of the lumbar nerve-roots—namely, sciatica, cruralgia, or neuralgia of the anterior crural. Aching across the hip and back and the base of

the sacrum: cramp, and at times paralysis. Inability to extend the thigh; bent position when standing; rotation inwards of the thigh. Children merely complain of a pain down the thigh, and always carry it flexed. Deep pressure in the abdomen, along the semilunar line, reveals a vertical, sausage-shaped, tender, fluctuating, elastic tumour (mistaken for loaded bowel, but which does not roll from under the fingers). It may or may not reach Poupart's ligament, and may be accompanied by a tumour of similar character in the iliac fossa.

The abscess may run its course without any subjective symptoms; the extra-abdominal tumour first attracting attention. When extra-abdominal, the usual physical signs show it to be abscess: and the impulse on coughing that it has intra-abdominal connection; combined pressure above Poupart's ligament and over the tumour in, e.g., the thigh, reveals fluctuation. Psoas abscess is most likely to be overlooked when symptoms of spinal or sacro-iliac disease are not co-existent.

Diagnosis.—For its most successful form of treatment, the abscess should be diagnosed whilst intra-abdominal. As stated above chronic psoas abscess must not be mistaken for loaded bowel. When in the groin the history, the imperfect reducibility, the absence of gurgling, and the presence of an intra-abdominal portion will differentiate it from hernia; while the presence of impulse will distinguish it from bubo. Acute psoas abscess must not be confounded with typhlitic abscess; this latter is generally more external, often emphysematous, and has a special history of its own.

Treatment.—(a) *Non-operative.*—Treat the cause, if discoverable, the abscess being left to itself; if the cause does not necessitate rest, the abscess, unless painful or producing œdema, will not do so. The chances of its absorbing cannot be calculated upon; and as most abscesses eventually discharge moving about hastens this end. A very large abscess, which spontaneously disappeared under the writer's observation, did not confine the patient to bed for even a day.

When inflamed and pointing, rest and fomentations are necessary; when it has discharged, a dressing of carbolic tow with iodoform (ten per cent.), is best. After the first day or two, the upright position aids discharge. A sinus usually results which can be dressed with boracic acid ointment. Tonics, according to circumstances, must be given.

(b) *Operative.* *Aspiration, Tapping.*—This is of use to relieve tension for a time

but is employed only when more radical measures cannot be adopted. Repeatedappings at one point will often determine the final pointing of the abscess. Complete evacuation should not be attempted at one time.

Free Incision.—This ought only to be undertaken when the fullest antiseptic precautions are adopted, both at the operation and subsequently. Whilst *intra-abdominal*, there are two places for opening a psoas abscess—one in the loin, the other just above Poupart's ligament; both wounds can be kept aseptic, but the former more certainly so; besides, it is the better one for drainage in the recumbent position.

Operation above Poupart's Ligament.—The incision is that for ligature of the external iliac artery. After division of the external oblique the knife is discarded; the rest of the tissues are turned up with the forefinger; and, when the fluctuating tumour is exposed, it is opened with dressing-forceps. A large drainage-tube is inserted, and a Listerian dressing, with the elastic taping bandage, applied. However opened, the abscess, if kept aseptic, should not be syringed out.

Operation in the Loin.—The patient being in the colotomy position, a vertical incision, four inches long, is made at the edge of the erector spinæ, its centre being, in the adult, two inches above and in the same line as the posterior superior iliac spine. Everything is divided till the quadratus lumborum is reached; this is then incised to the extent of two inches in the same direction. On reaching the anterior surface of this muscle, the sub-peritoneal fat is seen—a sure guide. The finger, now thrust into the wound in the direction of the base of the sacrum, feels a fluctuating tumour, especially if an assistant makes counter-pressure on the abscess in front. Where fluctuation is most distinct the abscess is now incised. Counter-pressure and rolling the patient backward will evacuate the contents, and the finger then explores for sequestra.

A perforated drainage-tube, at least three-eighths of an inch in calibre, and long enough to reach the iliac fossa, is then inserted, and its mouth stitched with two sutures to the skin wound, flush with the surface. The rest of the wound is now closed with deep and superficial sutures. Where full Listerian dressings (with spray) are used, the abscess need not be syringed out. Daily dressings are required for ten days; then the drainage-tube is shortened three inches, and at the end of three

weeks removed. In successful cases there may be no discharge of matter after the operation, the wound closing round the tube by primary union, and uniting completely on its removal. Two such cases have occurred to the writer. The patient must remain supine, with the thighs bent, and a pad firmly bandaged over Scarpa's triangle and along the line of the abscess in the abdominal walls.

When *extra-abdominal*, the abscess can be opened at its most prominent point; but the adductor region of the thigh should, if possible, be avoided, since it is impossible to ensure asepticism in that position. The writer has reached such an abscess through an incision outside the rectus femoris below the iliac spine, and thus ensured its evacuation away from the neighbourhood of impurities. When the abscess is opened in the inguinal region or thigh, the supine position is the worst for drainage, and the writer prefers getting such cases out of bed at the earliest opportunity.

Where psoas abscess is the result of sacro-iliac disease, and where matter is also presenting behind, over the joint, this posterior abscess should be opened and the joint explored. The psoas abscess may be finally evacuated by the same incision. The writer once trephined the joint and thus reached the abscess; the patient made a good recovery. C. HILTON GOLDING-BIRD.

PSORIASIS. (*Synon.* Lepra, Alphas.)

Definition. — Psoriasis is a non-contagious chronic disease of the skin, attended with the formation of roundish, slightly raised red patches, thickly covered with pearly-white scales.

Symptoms and Pathology.—Psoriasis, though an inflammatory disease, is one in which the inflammation is often so slight as to escape notice. At other times, it is well marked and attended with the usual signs of redness, itching, and other subjective sensations. The eruption consists at first of small slightly raised red patches, which spread at the margin and quickly become covered with silvery-white scales; these form rapidly, and as the disease increases are shed in great quantities. In some few instances the scales are not shed, but become heaped up into conical masses. In psoriasis there is no moist exudation on the surface of the skin, but it is not difficult to produce, artificially, an exudation of this kind by over-stimulating the patches, especially when they are present on the flexor surfaces of the body. Under these circumstances the disease may be easily mistaken

for eczema. The white scales are a characteristic feature of the disease; they consist of imperfectly formed, dry, epidermic structures, the silvery-white appearance being due to the presence of air in this epidermic accumulation. Psoriasis spots have a strong tendency to spread at the circumference and heal in the centre, and thus ringed or gyrated patches are produced. As the spots disappear they often leave behind considerable pigmentation of the skin.

The disease may attack exceptionally any part of the body, but is not common on the penis, scrotum, and face below the forehead, and very rare on the soles and palms. There is, however, a common form of dry eczema of the palm, which is often miscalled Psoriasis palmaris. The parts of the body most liable to the disease are the extensor surfaces of the limbs, especially the point of the elbow and the skin just below the patella; when, however, the disease is scattered in small spots over the trunk (Psoriasis guttata) the elbows and knees often escape. The disease is generally developed symmetrically on both sides of the body. It is probable that psoriasis does not attack the mucous membranes; there is, however, one form of leukoplakia buccalis which has a superficial resemblance to psoriasis, but it does not occur especially in those subject to that disease, and is probably not in any way related to it nor to ichthyosis, by which name it is sometimes erroneously called.

Etiology.—Psoriasis never occurs in infants at the breast, and hardly ever before the age of four or five; in this respect it presents a strong contrast to eczema. It is equally common in males and females. There are two varieties of psoriasis commonly met with. One appears for the first time in early life, usually before the age of twenty; it is attended with little or no itching and much scaliness; it almost invariably recurs after longer or shorter intervals; those subject to it generally have a fresh pink-and-white complexion. The other variety appears later in life, is attended with more marked inflammatory symptoms and especially with itching; the scales do not accumulate to any considerable extent. This variety is rather common in gouty families. The exciting causes of psoriasis are quite unknown.

Diagnosis.—A typical case of psoriasis cannot be mistaken for any other disease. In an irregularly developed form the disease may be confounded with dry eczema, lichen planus, tinea tonsurans of the trunk, and

scaly syphilitic eruptions. Psoriasis may be distinguished from dry eczema (1) by the fact that it generally attacks the extensor surfaces of the limbs; (2) that the patches are more raised and scaly, especially at their margins, which are always more defined than in eczema; (3) they heal first in the centre; (4) the history of the case. It is difficult to distinguish confluent patches of lichen planus from psoriasis. For the differential diagnosis, see *Lichen Planus* under PLANUS. Tinea tonsurans of the trunk sometimes assumes the appearance of healing psoriasis, but a few scales scraped from the surface, treated with liquor potassæ and examined under the microscope, will often aid the diagnosis. Psoriasis is perhaps more likely to be confounded with a squamous syphilide than with any other eruption. This is especially liable to occur when the psoriasis is in the form of crescentic patches or rings, and confined to the scalp and forehead. The absence of any syphilitic symptoms and the general appearance of the patient, together with a history of former attacks of the disease on the elbows and knees, will be valuable aids to diagnosis. The appearance of the eruption in psoriasis is of a more silvery-white colour and the pigmentation less than in squamous dermatosyphilis.

Treatment may be considered under two heads:—(1) General; (2) Local. To the former belong medicines and diet, and to the latter baths, ointments, and lotions. Of medicines used for the treatment of psoriasis, arsenic occupies the first place and should always be tried, unless some special circumstances contra-indicate its use. It may be combined either with acids or alkalies, according to circumstances, and should always be given either just before or after a meal. It must be admitted, however, that arsenic fails in a considerable number of cases, especially when the disease is associated with a gouty constitution. Under these circumstances, colchicum and small doses of iodide of potassium are sometimes very useful. The internal administration of turpentine or copaiba is occasionally beneficial, but they are remedies which are not usually so well borne as arsenic. Rules of diet, though not of the first importance in the treatment of psoriasis, should not be entirely neglected. In the psoriasis of the young, fat, and especially cod-liver oil, should form an article of daily food during the winter; in the psoriasis of middle life, especially if there be any gouty tendency, an abstinence from sugar, coffee, and beer is indicated.

(2) Of local remedies, baths are, on the whole, the most satisfactory and effective. The removal of psoriasis by baths is more lasting than by other local means, probably because the remedy is not simply local. An ordinary warm alkaline bath, in which the patient can soak for half an hour every evening before going to bed, is both an effective and pleasant remedy. The temperature of the bath may be regulated to suit the taste of the patient, and the addition of from two to three ounces of carbonate of potash will be sufficient for a full-sized bath. The best mineral waters for the treatment of psoriasis are those of La Bourboule in the Lower Auvergne; the local effect of these waters is also excellent. When psoriasis covers a very large area, it is not easy to apply local remedies except in the form of baths; but when the patches are confined to the limbs or scalp, tar lotions, especially the liquor carbonis detergens, are often very useful. The latter remedy may be used either pure or diluted with spirit, and painted on the spots with a large camel's-hair brush; thus applied it dries quickly, and is one of the best as well as one of the least disagreeable remedies. Goa powder (chrysophanic acid) has long been a favourite remedy in India for ringworm, psoriasis, and other scaly diseases. There are, however, several objections to its use. (1) Chrysophanic acid stains both the skin and clothes; (2) it is apt to set up too much inflammation, and thus cause considerable annoyance to the patient; in a few instances the writer has seen grave symptoms produced when chrysophanic acid ointment has been used over a large area. (3) The most serious objection to its use, however, is that psoriasis returns more quickly when removed by this means than when removed by any other method. Pyrogalllic acid ointment (ten to twenty grains of the acid to the ounce) is a useful local remedy, and not quite so disagreeable as chrysophanic acid ointment.

ROBERT LIVEING.

PSORIASIS BUCCALIS. — **LEUCOFLAKIA.**—This disease, which has long been known to surgeons, has in recent years attracted a large amount of attention in consequence of its relations to epithelioma. It has been more particularly described in connection with the Tongue, where its tendencies appear to be most serious, but all parts of the buccal mucous membrane are liable to the complaint.

Etiology.—Habitual irritation of the affected parts, especially in connection with

smoking, seems to be the chief causative agent; but the disease sometimes appears, without obvious exciting cause, in patients subject to psoriasis and other dry chronic forms of cutaneous eruption. Its relation to syphilis is somewhat doubtful, for although a history of hard chancre, with the usual sequences, may often be obtained in the great majority of cases, its origin is independent of ascertainable constitutional infection; and it appears probable that the rôle of syphilis is that of a common and not of a specific source of irritation, mucous tubercles, gummata, &c., acting merely by establishing an instability of the tissues in the parts attacked and a consequent susceptibility to malignant influence. In accordance with this theory of origin the disease is far more common in men, the consumers of tobacco, than in women, 101 cases out of 110 collected by Mr. A. E. Barker belonging to the former sex.

Symptoms.—The lesion as it appears upon the mucous surface of the lips, cheeks, palate, or tongue, is at first seen in the form of hyperæmic patches, which become developed into dull, whitish, roughened plaques of hypertrophied epithelium; and at a later stage may be associated with shallow fissures in the situation of the normal folds of the mucous membrane. On examination of the affected tissues, the epithelium is found to be more or less thickened and opaque, the papillæ at first enlarged, afterwards atrophied, and the submucous tissue infiltrated with white corpuscles, which extend chiefly along the course of the vessels. The anatomical changes in the parts entail no symptoms beyond the occurrence of a little salivation in the later stages, but the remarkable tendency to merge into epithelioma is a most important point for consideration. Mr. Barker has traced this sequel in no fewer than 43 instances out of 110 cases of buccal psoriasis.

The condition must be distinguished from the irregularly distributed scars and deep fissures left by the healing of gummatus lesions in tertiary syphilis.

Treatment.—All sources of local irritation, causative or otherwise, must be removed, the diet carefully regulated, and the mouth kept clean. The patients should be warned as to the possibility of remote trouble, and be kept under observation.

WILLIAM ANDERSON.

PTERYGIUM.—*Cause.*—The starting-point of a pterygium is generally an ulcer at the margin of the cornea, which, in

healing, catches a morsel of the limbus conjunctivæ and draws it towards the cicatrix, throwing the mucous membrane into a triangular fold. The ulcer then forms anew in the cornea immediately inside the cicatrix, and the point of conjunctiva is drawn into it again, and is carried a little further into the cornea, and so on.

The hollow lying between a PINGUECULA and the margin of the cornea is apt to lodge small foreign bodies, which cause shallow marginal ulcers, and these, in healing, draw the pinguecula over on the cornea.

In this country pterygium is a rare affection, but it is not uncommon in countries or localities where the air is filled with fine sand or other minute particles.

Symptoms.—Pterygium consists in a vascularised thickening of the conjunctiva, triangular in shape, situated most usually to the inside of the cornea, sometimes to its outer side, and rarely either above or below it. There is frequently, but not always, a tendency of the growth to advance into the cornea, as above mentioned; but it seldom reaches the centre, and still more rarely extends quite across the cornea. Vision is not affected, unless the growth advance over the centre of the cornea. There is no pain, and the disfigurement alone is what the patient complains of.

Treatment.—Unless the pterygium be very thick and have invaded the cornea to some extent, or be progressing over the cornea, it is well to let it alone; the more so as, by removing it, a perfectly normal appearance is not given to the eye, for a mark is necessarily left, both on the cornea and on the conjunctiva.

If the growth be progressive, or very disfiguring, it should be removed, other proposed methods of dealing with it being futile. This may be effected either by ligature or excision.

In the method by ligature, a strong silk suture is passed through two needles. The pterygium being raised with a forceps close to the cornea, one needle is passed under it here, and the other needle in the same way close to its base, and the ligature is drawn about half-way through. The thread is cut close behind each needle, thus forming three ligatures, which are respectively tied tight. In four or five days the pterygium comes away.

In excision, the apex is seized with a forceps and dissected up, either with a scissors or small scalpel, care being taken not to injure the true cornea. The dissection is continued towards the base of the ptery-

gium, where it is completed by two convergent incisions meeting at the base. The mucous membrane in the neighbourhood of the base is separated up somewhat from the sclerotic, and the margins of the conjunctival wound brought together with sutures.

H. R. SWANZY.

PTOSIS—Drooping of the Upper Eyelid. See *Third-Nerve Paralysis* under **OCULAR MUSCLES**, Affections of the.

PUDENDAL HERNIA.—This rupture appears in the posterior inferior part of the labium. The neck of the sac lies between the ramus of the ischium and the vagina. The sac on making its way to the labium must pass through the anterior fibres of the levator ani. This form of rupture is most common in women past middle life, who have borne several children. The protrusion is usually small and contains small intestine. It has been mistaken for a labial cyst. It is usually readily reduced, and gives but little trouble. It has been strangulated, and has—when in that condition—been successfully reduced by taxis. It would appear that in no reported case has herniotomy been required. FREDERICK TREVES.

PULMONARY ARTERY, Wound of the.—This is a rare accident, but it occasionally takes place in stabs or shot-wounds. In the former it may be the only vessel wounded, from its anterior and comparatively superficial position in the chest. If the vessel be wounded before its bifurcation, the accident must necessarily be of an exceedingly fatal character. On account of the way in which the serous pericardium wraps round both this vessel and the aorta, the wound must perforate the upper part of the pericardium, and extravasation of blood from the vessel must take place directly into the pericardial sac, and thus cause very speedy death, as in incised wounds of the heart, by filling up this sac with blood and impeding the action of this viscus. Such a wound may perforate through into the ascending part of the arch of the aorta, and thus form a communication between these two vessels.

In those cases in which the artery is wounded beyond its bifurcation, the blood extravasates into the root of the lung, and hence into the posterior mediastinum. Such wounds, which are generally of a very complicated character, are sometimes the cause of immense extravasations of blood into the posterior part of the chest. The prognosis in all such cases is exceedingly grave.

The diagnosis is generally obscure, the symptoms much resembling those of HÆMOTHORAX, the treatment also being the same.
H. G. HOWSE.

PULPY DEGENERATION OF SYNOVIAL MEMBRANE. See JOINTS, Diseases of.

PULSE.—The pulse affords valuable indications for the surgeon, and a careful study of it is essential for diagnosis, prognosis, and treatment. It is one of those indications of the condition of a patient which is very readily obtained, and obtained also without the intervention of instruments; and for this reason it is deserving of very special attention. The *tactus eruditus* applied to the radial artery at the wrist may give the first warning to the operator that the patient has cardiac trouble, and is therefore a bad subject for anæsthetics or the knife; or that he has a granular contracted kidney, and is, therefore, not well fitted for operative interference. It tells him more, probably, than any other source of information, concerning his patient's 'strength' (i.e. the strength of the muscles of organic life), and of his progress towards recovery or death; and, above all, the administration or withholding of stimulants can only be properly regulated by one who is able to value properly the indications afforded by the pulse.

The pulse is usually 'taken' by placing the tips of the right index, middle, and ring fingers upon the radial artery of the patient, as it lies upon the bone just above the left wrist. With each stroke of the heart the artery is felt to dilate. This constitutes the 'pulse,' of which we have to note the rapidity and the other characters which form the subject of this article. The radial artery is usually selected because of its accessibility and convenience. Occasionally, the radial artery (owing to abnormal distribution or other cause) is not available, and then we may have recourse to the temporal, brachial, or any other superficial artery of the body.

By feeling the pulse we estimate mainly two things—(a) the rate at which the heart is working; (b) the pressure of blood in the artery. The rate is always stated in terms of pulsations per minute. The pressure is estimated by noting the force needed to stop the pulse with the fingers. In the healthy person it may be stated, as a rule, that pressure is inversely as the speed. A heart that hurries is often to some extent inefficient, and fails to maintain the pressure in the vessels. Again, the pressure in the

vessels is far more dependent on the state of the arterioles and capillaries than on the force of the heart's action, and raising the pressure has the effect of raising the tone of the vagus centre in the medulla, and consequently of slowing the heart. The converse also holds good.

THE PULSE-RATE varies with *age*, as shown by the following table:—

In the fœtus	140 to 150
Newly born infant . . .	130 „ 140
During 1st year	115 „ 130
„ 2nd „	100 „ 115
„ 3rd „	95 „ 105
From 7 to 14	80 „ 90
„ 14 „ 21	75 „ 85
„ 21 „ 60	70 „ 75
Old age	75 „ 80

The influence of *sex* is considerable, and Dr. Guy has determined that the pulse of the adult female is quicker, by from 10 to 14 beats, than the pulse of the adult male.

The effect of *muscular exercise* is to quicken the pulse, the increase in pulse-rate being proportioned to the effort made. Thus, the pulse is quicker when standing than when sitting, and quicker when sitting than when the body is at complete rest in the recumbent position.

The effect of *position* apart from muscular effort is shown to be considerable. It is stated by Graves that the erect posture, as compared with the horizontal, increases the pulse-rate in a healthy person from 6 to 15 beats. This difference increases with the frequency of the pulse at the time of the experiment; thus, if it has been raised to 90 or 100 by moderate exercise, it is not unusual to find the difference 20 or 30. Dr. Graves found that this variation of pulse-rate with posture did not depend entirely upon the muscular effort involved in maintaining the posture, and that, when the position was changed by means of an apparatus which excluded the factor of muscular effort, the variations of pulse were nearly as great as when posture was changed by means of the patient's own exertions.

The pulse, according to Graves, is also 'evidently stronger in the horizontal than in the erect posture; consequently its *maximum of strength and minimum of frequency* are attained together.' This constitutes one of the reasons for placing persons horizontal for the relief of syncope.

A somewhat extended study of the effect of posture on the pulse-rate enabled Graves to conclude—

1. That the greatest difference occurs in patients labouring under fever, or in a

debilitated state in consequence of fever or any other cause. It may amount to 30, 40, or even 50, between the horizontal and erect postures.

2. That this difference decreases after the first quarter of an hour (i.e. after the subsidence of the variation due to exertion of muscular effort), but always remains considerable as long as the same position is observed.

3. That in persons not much debilitated the difference is much less, and often does not amount to more than 10.

4. Generally, the pulse-rate in the sitting posture may be taken as the mean.

5. In persons convalescent from fever or acute diseases, it is extremely useful to the physician to ascertain the comparative frequency of the pulse in the horizontal and in the erect posture. The greater the difference, the greater is the debility of the patient, and, consequently, the more guarded must his medical attendant be in allowing him to sit up for any length of time, particularly if the pulse, on his lying down, does not resume its usual degree of frequency.

Dr. Graves also asserted that, in cases of considerable hypertrophy and dilatation of the heart, the variation of pulse-rate with variation of position is often not observable, and he concludes 'that in a debilitated person, when a sudden change of position makes no difference in the frequency of the pulse, we may conclude that the heart, or at least its left ventricle, is increased in size and strength.'

The pulse-rate is influenced by *temperature*; and it has been shown that when animals are exposed to high temperatures it rises, and when exposed to low temperatures it falls. In fever there is, speaking generally, a correspondence in direct ratio between the body-temperature and the pulse-rate—i.e. they both rise and fall together, or, to be more accurate, the variations in pulse-rate usually follow by a little the variations in temperature. When the temperature is high, it is found that influences which disturb the pulse-rate (such as mental emotion, muscular effort, and posture) act with undue force, and thus it often happens that the pulse-rate runs ahead of the temperature.

The pulse-rate in fever, like the temperature, is subject to daily fluctuations, having a morning minimum and an evening maximum. In mild cases of fever a pulse of 100 is common. In more severe cases it runs up to 120 or 130; but if a rate above this (say 140) is maintained for any time it

makes the prognosis grave. Towards the end of fevers which terminate fatally, we may have a falling temperature and a rising pulse—a condition which is always grave. In heart-disease, we may have a rapid pulse with a sub-normal temperature. In tubercular meningitis or in other fevers complicated by mischief at the base of the brain, we may have a high temperature with a sub-normal pulse. In short, there is a rough correspondence between pulse-rate and temperature, and, when we find such correspondence wanting, we should always search for the cause.

We may have a very rapid pulse without rise of temperature. This is notably the case in Graves's disease or exophthalmic goitre, in which the pulse-rate may reach 160 in a minute. In poisoning by atropine, a rapid pulse occurs, due, as is supposed, to a paralysis of the inhibitory apparatus in the heart. Similarly, Guttman records a case of very rapid pulse (160), unaccompanied by rise of temperature, and due to compression of the vagus nerve by swollen lymphatic glands.

Mental and emotional excitement has been known to quicken the pulse. *Diminution of atmospheric pressure* does the same thing, and Mr. Glaisher records that in rising in a balloon from the ground to a height of 20,000 feet, the pulse-rate rose gradually from 76 to 110. It would be impossible entirely to eliminate the effect of mental excitement in this experiment.

In valvular disease of the heart the pulse is usually quickened, and especially, also, during an acute inflammatory condition such as peri-, endo-, or myo-carditis. A fatty heart often causes a slow pulse; sometimes remarkably slow, falling below 30.

The pulse may be *irregular in force and rhythm*. This may depend upon organic disease (valvular) of the heart; upon disturbed innervation, which may be central (as in tubercular meningitis), reflex (as in dyspeptic conditions), or toxic (as from digitalis and the excessive use of tobacco). Irregularity is common in old people, and seems generally (in the absence of cardiac disease) to cause no trouble, and probably does not influence the expectation of life.

Sometimes, the irregularities are very regular in their intervals of occurrence, sufficiently so to have a pseudo-mystic title, and accordingly we find in books the words *bigeminus*, *trigeminus*, and *alternans* applied to irregular pulses. The last form occurs when the left ventricle is so weakened that only every other contraction makes

itself felt at the wrist. 'Intermission of the pulse at irregular intervals may be due to similar causes. It may accompany heart-disease or may occur in persons otherwise healthy.

In considering the pulse, it must be borne in mind that the capacity of the blood-vessels is far more than is sufficient for the blood which they hold. When the vessels are relaxed, the blood does not nearly half fill them. In a 'full-blooded' man who has died suddenly, we find *post mortem* the arteries empty, and the veins by no means distended. During life, the vessels contract on their contents, but, their potential capacity being so great, it is evident that unequal contraction in different areas of the body leads to unequal distribution of blood. In health, the blood-distribution is always proportioned to the need of the part, the need to the work being done. When there is a 'determination' of blood to any part, there must be a compensating emptiness of some other part. When the surgeon stands his patient against a wall, and, passing a catheter, draws off perhaps a gallon of urine from an over-distended bladder, the sudden removal of pressure from the belly causes a sudden flow of blood into the vessels of that part, with the result that the brain and medulla are suddenly starved of blood, and the patient falls down senseless and faint.

THE VOLUME OF THE PULSE varies in individuals. It may be of different volume at the two wrists, and this may depend upon irregularity in the distribution of the radial artery, or it may depend upon some pressure or obstruction in the main trunks either inside or outside the thorax.

The pulse may be of small volume (a) from loss of blood; (b) from failure of the heart to supply the required amount to the arteries, as in mitral or aortic obstruction and cardiac failure; (c) from pressure upon the aorta; (d) from diversion of the blood-stream, producing relative emptiness of the radial artery. This occurs in peritonitis and collapse, in which there is dilatation of the abdominal vessels. It is at the commencement of peritonitis, when there is determination of blood to the abdominal vessels, and before the muscular tone of the arteries or the muscular power of the heart has begun to fail, that we get the so-called 'thready pulse' (small and hard), which is almost diagnostic of abdominal inflammation.

When the heart is hypertrophied from aortic disease, the volume of the pulse is large. In advanced atheroma of the arte-

ries, there is often a seeming increase of volume from the increased thickness and tortuosity of the vessel.

The *hardness* or *softness* of the pulse, the ease with which the pulse can be arrested by pressure of the finger, is most important from a diagnostic point of view. If the volume of blood be normal, if the left ventricle be hypertrophied and the aortic valves efficient, if the arterial wall be thickened from muscular or fibroid increase, and if the emptying of the arteries be hindered by contraction or thickening of the arterioles and capillaries, then the compression of the pulse is necessarily difficult, and we get the high-tension pulse which is so common with gouty kidneys, arterio-capillary fibrosis, and hypertrophied heart.

The causes above mentioned which, when they concur, produce a high-tension pulse in its most marked form, may not all be present simultaneously, or some of the causes of high tension may be counteracted by others which tend to produce low tension, such as deficiency of blood, mitral obstruction, cardiac weakness, or loss of tone in the blood-vessels from anæmia or acute febrile diseases. A soft compressible pulse, occurring in febrile diseases, indicates weakness and a failure of the muscles of the heart and vessels.

When the left ventricle is greatly hypertrophied and the aortic valves are inefficient, we have a very marked and forcible distension of the artery with sudden collapse, owing to the failure of the valves to maintain the pressure in the vessel. This is the *quick-bounding* pulse of some writers, otherwise known as the *water-hammer* pulse or Corrigan's pulse. Owing to the great distension of the vessels, the pulse is often *visible* in the arteries throughout the body, and visibility of pulse is to be reckoned amongst the surest indications of aortic incompetency. Visibility and hardness of the pulse also occur in advanced atheromatous disease of the vessels in persons advanced in life. It may occur also in healthy individuals in a state of nervous excitement.

A very important form of pulse is the so-called *dicrotous* pulse, in which for each contraction of the ventricle there are two pulsations in the artery.

It must be remembered that dicrotism is a physiological phenomenon which, by the use of the sphygmograph, can be seen to be always present in the pulse. It is only, however, when dicrotism reaches a high degree, that it can be detected by merely

placing the finger on the artery. Dicrotism is a sign of weakness, and appears to be due to a want of tone or failure in power of the muscular coat of the artery.

When the ventricle contracts, the tidal wave of blood distends the elastic artery; this distension ceases with the cessation of the ventricular contraction. The artery then recoils, and the force of the contracting artery closes the aortic valves and, at the same time, gives an impulse to the blood in the vessel, which travels to the periphery. This 'dicrotic' wave, though always present, only becomes manifest when it is excessive. The elasticity of the arteries depends upon (a) yellow elastic tissue, the action of which is mainly, if not entirely, mechanical and independent of central control, and (b) muscular element, in which the elasticity is 'vital,' and subject to great variations. The amount of elastic and muscular elements present in an artery bear an inverse proportion to each other, the latter increasing as the former decrease. The muscular elements in the radial artery at the wrist are present in relatively large proportions, and one of the effects of their activity is to check the oscillations of the vessel and render the dicrotic wave impalpable. When the artery loses its tone and the muscular coat is paralysed, as happens in acute and severe febrile conditions, then the dicrotic wave is easily felt, and its presence is made the more striking in consequence of the smallness of the tidal wave, caused by the failing power of the ventricle.

A dicrotic pulse is usually the accompaniment of high fever, and indicates that the powers of the patient are failing. It is sometimes the precursor of hæmorrhage (according to Graves), and is often observed as an immediate sequel of extensive hæmorrhage. In fever, says Graves, a dicrotous pulse, which is at the same time hard, is a *very bad* symptom if it lasts more than twenty-four hours; when succeeded by epistaxis, and when it disappears after moderate epistaxis, it is not bad; when it lasts for many days without any tendency to hæmorrhage, the case, nine times out of ten, ends fatally.

'In hæmoptysis, epistaxis, and internal inflammation, a very hard dicrotous pulse sometimes occurs, which resists all treatment and portends a fatal issue; no matter how much the other symptoms may improve, so long as the pulse continues of this character, the patient is in imminent danger.'

THE PULSE-RESPIRATION RATIO is a point which always demands attention. As a

rule there are, on an average, four beats of the pulse to each respiratory act, and the healthy individual has eighteen respirations and seventy-two pulse-beats per minute. Any persistent disturbance of this ratio should excite suspicion. If the pulse-respiration ratio changes from 4:1 to 3:1 or 2:1, the lungs should be carefully examined, and in the majority of cases they will be found the seat of disease. The quickening of the respiration is usually proportioned to the amount of lung-damage. Thus, in double pneumonia, where the amount of lung available for respiration is reduced to a minimum, the breathing is often enormously quickened, and, notwithstanding great rapidity of the pulse, the pulse-respiration ratio may be 2:1.

In pleurisy and bronchitis the ratio is usually less disturbed than in pneumonia. Sometimes, while the pulse is quickened the respirations are slowed. This is observed in a very marked degree in opium-poisoning, in which the respirations get gradually slower, while the rapidity of the pulse is above normal. In some cases of delirium tremens the same phenomenon is observed. In hydrophobia also, towards the end of the case, the respirations may become very slow and very unequal in rhythm, while the pulse remains rapid.

Speaking of the importance of the pulse-respiration ratio, Graves says: 'A quickening of the breathing in fever, without any particular lesion of the thoracic viscera, is always a proof that the muscular powers of organic life have been injured; that the diaphragm and respiratory muscles are impeded in their functions, and that the case is of a dangerous character.'

The pulse affords valuable *indications for treatment*, especially in acute conditions, whether medical or surgical, in which the administration of stimulants is necessary to enable a patient to tide over a crisis. To use stimulants with intelligence is of the greatest importance, and the surgeon must always bear in mind the difference between stimulants and food, a difference of the same kind as that which exists between the spur and a feed of corn in relation to a horse. The analogy is only partly correct, however, for there can be no doubt that alcohol may serve as a food, and especially would this seem to be the case in fevers with high temperature.

If the pulse tells us that the muscles of the heart or arteries are failing, if want of force is being compensated by undue rapidity, if the pulse be soft, compressible, or especially if it be dicrotous, then stimulants

re advisable, and, judiciously given, will enable a patient to recover from a condition which might otherwise be fatal.

Alcoholic stimulants act quickly, and the surgeon should always ascertain, within a quarter of an hour or so after their administration, if the indications for which the stimulants are given have diminished. If stimulants are being useful to a patient, this should always be the case. The rapid pulse should be slower, the soft pulse firmer, and the dicrotous pulse less dicrotous. Or, if stimulants be administered to quicken the action of a slowly acting heart, the end ought to be fulfilled and the pulse ought to be more rapid within a short time of administering the stimulants.

It is a golden rule never to give a dram of alcohol which is not necessary, it to keep it in reserve in case of need. Stimulants, in acute conditions, should be given in small doses and at frequent intervals. Directly the indications for which the alcohol has been administered have been met, it should be discontinued, or the dose lessened. It is especially in acute cases of high fever, in which it is impossible to give food, that alcohol is of use. In cases of failing heart from hæmorrhage, alcohol is generally contra-indicated, and solid food, which is easily digested, is likely to be of more service to the patient.

G. VIVIAN POORE.

PURPURA.—*Definition.*—Purpura is, in the modern acceptation of the term, synonymous with non-traumatic hæmorrhage into the skin and mucous membranes, and occurs in both sexes and at all ages.

Etiology.—The causes of cutaneous hæmorrhages are very numerous, and may be classified under five heads:—

1. Blood-alterations caused by—(a) specific fevers, especially typhus, variola, hæmorrhagica and epidemic cerebro-spinal meningitis; less often by typhoid, measles, scarlatina, acute septicæmia, pyæmia, and phthisis; (b) snake-poison; (c) some drugs, where there is an individual idiosyncrasy, as iodine, iodide and bromide of potassium, quinine, salicylic acid, copaiba, and ergot of rye, chloral, &c.; (d) certain general diseases, as scurvy, hæmophilia, leucocythæmia, pernicious and other anæmias, rickets (scurvy rickets); (e) cancer, as in tuberculosis and cancer.

2. Many diseases of the viscera, including some of those of the spleen, liver (especially cirrhosis and chronic jaundice), intestines, kidney (especially chronic

Bright's disease), lung and cardio-vascular system, acting probably and mainly through the sympathetic.

3. Want of support to the vessels, due to—(a) Relaxation of the tissues, as in old age (*P. senilis*), getting up after long illnesses, parturition, &c.; or (b) the existence of other eruptions, especially bullæ or wheals.

4. Sudden changes in the circulation, as in purpura in the new-born (*P. neonatorum*).

5. Diseases of the nervous system—(a) Functional, in connection with shock, grief, epilepsy, angina pectoris, and other neuralgias; (b) organic, as in tubercular meningitis, plugging of cerebral sinuses and some other serious lesions, also in posterior myelitis, injuries to nerves, &c.

Pathology.—Blood may escape from the vessels by rupture, diapedesis, or by transudation of blood colouring matter only; the last two play an unimportant part, and there is no doubt that, in the majority of cases, rupture of the vessel takes place. This may occur from—increase of blood-pressure behind the point of rupture, especially if suddenly produced, and the commonest cause of this is some obstruction in the vessel, which may be due to stasis from inflammation or some external pressure, thrombosis or embolism. Extreme contraction of the vessels on the one hand, or dilatation on the other, may also lead to rupture of the vessel. In another class of cases the rupture may be due to changes in the vascular walls, from inflammation or degeneration. A third class are due to changes in the nervous system, which may produce variations in the calibre of the vessels or alterations in the nutrition of their walls.

Blood may be extravasated into the tissues either between the layers of the epidermis or into the papillæ and corium; or more rarely into the sweat-glands, hair-follicles, and subcutaneous tissues. The changes that take place in the absorption of blood-clots are as follows:—The serum is first absorbed with the broken-down corpuscles, later the fibrin shrinks, liquefies, and is also absorbed. The variety of colours seen during life is mainly due to hæmatin changes. The hæmatin escapes from the corpuscles and stains the fibrin and serum; after they are absorbed it remains as yellow or reddish-brown granules, either scattered or aggregated. In some cases the hæmatin remains in the corpuscles, and then these shrink into a granular mass, and the hæmatoidin finally separates into yellowish or

ruby red rhombic columns or tables. Small hæmorrhages leave no trace behind, but the larger or deeper ones leave a more or less permanent pigmentation due to hæmatoidin.

When hæmorrhages take place into mucous membranes, erosion of the membrane frequently results, and hence it is common to find ulcers of this kind, often of a considerable size, in the stomach, intestines, &c.

Symptoms.—The most common are petechiæ or spots beneath the epidermis, from an eighth to half an inch in size, of a bright red to a claret or deep purple colour at first, but changing, as absorption takes place, into the bluish, greenish, yellowish, and brownish tints of a fading bruise; round or irregular in shape, sharply defined, but with finely ragged edges. They are seldom raised, are unaltered by pressure, come anywhere, but mostly in dependent positions, are never transitory, never increase in size except by fresh hæmorrhages, and remain visible after death; they are unattended by itching or any other alteration of sensation.

Besides the numerous cases in which the cause is known, there is a large remanet occurring in apparently healthy individuals, presenting some varieties which necessitate a separate description; but it must always be borne in mind that the differences between them are mainly in degree, or in the accompanying symptoms.

Varieties.—These are three in number.

1. *Purpura simplex.* This may be considered as the type of the affections to which the name of purpura was formerly restricted. In this form, apparently spontaneous hæmorrhages make their appearance suddenly, often in the night, and generally without previous symptoms. In adults the hæmorrhages come first, most frequently upon the lower extremities, especially the flexor aspect of the thighs and calves, and in children upon the neck and upper part of the arms, but almost any part may be attacked. The lesions are mostly petechial, of any size, roundish or oval, but may be irregular. They come in crops, are usually symmetrical but occasionally unilateral, and give rise to no inconvenience. Fresh crops of petechiæ continue to appear for a period varying from a few days to a few weeks.

Sometimes the outbreak of hæmorrhages is preceded by lassitude, aching in the limbs, especially the calves, anorexia, and general malaise, but these symptoms are more common, though not invariably present in 2. *Purpura hæmorrhagica*, which may

be regarded as an exaggerated *P. simplex*, and is often preceded, in addition to the above symptoms, by headache, great debility, and even convulsions. The lesions present every variety of aspect; beginning upon the legs and lower part of the trunk, they rapidly involve by successive crops the whole of the body-surface. Sooner or later the hæmorrhages take place internally, especially from the mucous membranes, into the parenchyma of organs and various serous cavities; and epistaxis, hæmoptysis, hæmetemesis, hæmaturia may ensue so profusely as to rapidly undermine the strength of the patient and lead to speedy death by exhaustion; or the fatal event may be produced by the position of the hæmorrhage—e.g. the meninges or brain-substance. Or, again, the bleeding may be more moderate and continue for a few weeks, or may cease altogether in about a fortnight, either abruptly or gradually, the general health being affected in proportion to the amount of the hæmorrhages.

3. *Peliosis*, or *purpura rheumatica*, generally described as a variety of purpura there can be, however, little doubt that it is an exudative erythema, with superadded cutaneous hæmorrhages, which in rare instances have amounted to *P. hæmorrhagica*. The affection is uncommon; in the patient complains of malaise, lassitude and pains of moderate intensity in the limbs, especially the joints, which are often slightly swollen and tender; after lasting a few hours up to a day or two, during the evening or night an eruption appears, and the pains then often abate, but sometimes the eruption precedes the pain. The eruption is generally most abundant in the neighbourhood of the joints in which the pain has been greatest, and upon the calves; the knees and ankles are always, the elbow and wrists frequently, and the trunk rarely involved. The eruption is petechial upon the calves and may be so round the joints but more frequently the lesions there consist of slightly raised papules or patches, bright red at first, like an erythema papulatum but unaltered by pressure and soon becoming purplish. The temperature may be raised three or four degrees, but this elevation has no apparent relation to a fresh attack, the joint-affection, or the eruption, and the temperature is often normal when all the other phenomena are as severe as in those in which there is marked fever; the pains subside in a few days, but the hæmorrhages take the usual time for absorption. Even without the recognisable presence of rheumatic fever, valvular heart-disease has

occasionally ensued. Albuminuria and hæmaturia have been seen, but in rare instances.

Diagnosis.—Purpura simplex has to be distinguished sometimes from erythema papulatum and flea-bites. The fact that the purpura spot is unaltered by pressure distinguishes it at once from erythema, which only resembles when the petechiæ are of a brighter colour than usual. The later stage of flea-bites is exactly like the petechiæ of disease, but they do not come suddenly in crops, have a ring of congestion round them at the commencement, and a central unctum is discernible for the first few days. P. hæmorrhagica has only to be distinguished from certain other symptomatic hæmorrhages. Scurvy most closely resembles it, but this disease is invariably due to the deficiency of vegetables in the dietary, while P. hæmorrhagica has no relation to diet; moreover, the distinctive premonitory symptoms—great prostration, frequent faintings, and later, swelling of the gums, loose teeth, and the characteristic brawny swelling of the limbs—always accompany a well-marked case of scurvy.

The history of hæmophilia, and the general symptoms of leukæmia and pernicious anæmia, will always distinguish these diseases from P. hæmorrhagica.

The diagnosis of P. rheumatica is easy; joint-pains, and purpura without symptoms of other disease, are generally sufficient to establish it. The rare cases of embolic purpura, due to ulcerative endocarditis in the course of rheumatic fever, would be distinguished by the high temperature and more general condition.

Prognosis.—The majority of cases terminate favourably, but the duration is very variable; and as we have nothing to guide us as to the course the case will pursue, even the simplest cases sometimes passing without assignable cause into severe forms, it is well to be guarded in prophesying the termination. In purpura rheumatica the patients nearly all get well, but often take a long time, and the disease is very liable to recur.

Treatment.—Cases of moderate severity often require no treatment, or only that appropriate to the general condition, in which the purpura is intercurrent; but rest in the horizontal position is one of the most important precautions, and should be rigorously insisted upon in all cases except the slightest. In purpura hæmorrhagica, every effort should be made to support the strength from the first by nourishment in an easily assimilable form; but diet has no influence

upon the hæmorrhage, except when it is dependent upon general disease like scurvy. When the hæmorrhage is sufficiently severe to be treated, or is the only symptom present, the drugs upon which most reliance can be placed are the liquid extract of ergot and ergotin injected subcutaneously. Turpentine internally and by inhalation, ice internally and externally, are often useful, and local astringents may sometimes be tried in severe cases: in one apparently desperate case, faradisation of the whole surface seemed effectual. Perchloride of iron, quinine, and general astringents have their advocates, but, from what is already known of the pathology of purpura, it is not surprising that in some cases all remedies should fail.

Purpura that is intercurrent in general conditions rarely requires separate treatment, except in diseases like scurvy and hæmophilia, where it is very profuse. The treatment of peliosis rheumatica is scarcely more satisfactory; rest is essential, and a liberal dietary should be prescribed. Salicylate of soda often gives relief to the pains, though it does not seem to exercise much influence over the general course of the disease; quinine and iron separately or in combination are beneficial in some cases, but many run their course uninfluenced by treatment. People who have had one attack should take the same precautions as those who have had rheumatic fever, and carefully guard against exposure to rapid alterations of temperature.

H. RADCLIFFE CROCKER.

PURPURA URTICANS. *See* URTICARIA.

PUS. *See* SUPPURATION.

PUSTULAR OPHTHALMIA. *See* CONJUNCTIVA, Diseases of the.

PUSTULE, MALIGNANT. *See* MALIGNANT PUSTULE.

PYÆMIA is the name given to a group of morbid processes, which are characterised generally either by peculiar local and constitutional symptoms, or by the presence in the blood of a specific infective organism. Two fairly well-marked forms may thus be distinguished; one, in which the prominent symptom is fever, caused by the entrance into the blood of an organism having the power of multiplying itself indefinitely, accompanied or not by local lesions such as venous thrombosis, embolic abscesses in the viscera, acute suppurations of the serous or synovial spaces, multiple abscesses in the

connective tissues, and eruptions on the skin; the other, in which local troubles of the same nature are present, but in which the constitutional symptoms do not attain such prominence, and the infection by a specific pathogenic organism is uncertain.

In spite of the views held by Koch, Davaine, and others, as to the relationship between pyæmia and septicæmia, it does not seem advisable to regard the presence of metastatic abscesses as the criterion by which to distinguish one from the other. They are not of necessity present in all cases of pyæmia; the infective process may prove fatal before there is time for them to develop; and some, at least, may be present under other conditions without there ever having been true infection at all.

Burdon Sanderson, in his lectures on the 'Infective Processes of Disease' (*Brit. Med. Journ.*, Dec. 29, 1877), says: 'What I mean by septicæmia is a constitutional disorder of limited duration, produced by the entrance into the blood-stream of a certain quantity of septic material. It must, therefore, be regarded, not so much as a disease, but as a complication, differing from pyæmia, not only in the fact that it has no necessary connection with any local process either primary or secondary, but also in the important particular that it has no development. Pyæmia is a malignant process which goes on and on to its fatal end; but in the case of septicæmia, inasmuch as the poison which produces it has no tendency to multiply in the organism, there is no reason why the morbid process should not come to an end of itself, unless either the original dose is fatal or a second infection takes place from the same or another source.' The one is septic intoxication due to the absorption of chemical products of decomposition, exceptionally attended by local mischief; the other embraces a group of diseases, of which one at least is due to the multiplication in the system of a pathogenic organism, and in all of which metastatic inflammations so frequently occur that their presence is held to stamp the disorder as pyæmic, even when no evidence of a germ can be found. From the evidence collected by the committee of the Pathological Society it seems probable that among the cases returned as pyæmic were some (1) in which the constitutional symptoms were so severe as to prove fatal before any local manifestations could have made their appearance; others (2) in which these were present as complications often causing death from their affecting vital organs; and (3) a third class, in which local

thrombosis gave rise to local abscesses (often confined to the lungs) and death, with the evidence of any pre-existing systemic infection.

There may be distinguished in the majority of cases of pyæmia two series of morbid processes: first, the general constitutional disturbance due to the system poisoning; and, secondly, local metastatic inflammations consequent on this, but sometimes present independently. The former, these, it is admitted, is caused by the circulation of some animal poison in the blood, but beyond this fact nothing is certainly known. Pyæmia derived its name 'puilent infection,' from the idea that the material introduced was pus, which was carried round by the blood and deposited in various parts affected. It was pointed out in proof of this, that the disorder was commonest after injuries involving structures full of venous channels, particularly if the veins when cut were in any way prevented from collapsing; that it very rarely occurred in wounds which healed by the first intention; and that it was especially frequent when the pus spread from the seat of injury along the planes of cellular tissue surrounding and bathing the exterior veins whose swollen and thickened walls enclosed a broken-down semi-fluid clot. It was this pus-like fluid, supposed to be a secretion of the inflamed *intima*, and generally prevented from entering the circulation by the protecting coagulum, which sometimes was carried off to form metastatic deposits.

Further observation, however, soon made it clear that the metastases were not merely deposits of pus in the viscera, but true inflammatory foci, abscesses set up by the irritant conveyed to them by the blood, and, further, that this irritant could not be healthy pus, for, when this was injected into the blood-stream, it only set up a slight and transient pyrexia, and if it blocked blood-vessels anywhere, caused, not an abscess, but a purely passive mechanical infarction. If, however, the pus had been allowed to remain exposed to the air and become putrid, the most violent reaction followed, all the symptoms, local and constitutional, of pyæmia setting in with extreme severity. Evidently some cases had been produced during the process of decomposition (by which was understood ordinary putrefaction, attended by the presence of minute organisms), and it was once concluded that pyæmia was due to the entrance into the circulation of the septic germs. The unorganised poison

could be extracted from putrefying pus caused septic intoxication, in which the severity of the symptoms, other things being equal, was directly proportionate to the quantity injected, and there was no reproduction of the poison in the animal's body, so that a drop of its blood taken immediately after death contained only a minute proportion of the original amount, and caused scarcely any disturbance. If, on the other hand, the organisms found their way in, so, though the general symptoms might be the same, they did not set in at once, and the poison while in the blood increased in quantity, and perhaps in virulence, to such an extent that the most minute trace was sufficient to cause the most unlimited effect. It was a living poison, associated with the presence of living organisms, and from the analogy of such diseases as that caused by the bacillus of anthrax, they must be the cause of the symptoms; like living organic ferments, which, while growing, can evolve at the expense of the material they absorb some substance capable of producing rapid and extensive chemical changes. This was septic infection.

Putrefaction ($\sigma\eta\psi\iota\varsigma$), in the ordinary acceptance of the term decomposition with the evolution of stinking and offensive gases, is not, however, absolutely essential. Though they must be very closely allied, and usually do occur together, the organism that is the cause of pyæmia cannot be the ordinary bacterium termo, or the equally common form of bacillus. In certain cases putrefaction is not present at all; the exceedingly virulent poison in the bodies of those who have died of puerperal peritonitis diminishes in activity as decomposition advances; and Dowdeswell (*Proc. Roy. Soc.*) has shown, by experimenting on animals after the fashion of Davaine, that the action of putrid bullock's blood, so far as its specific infectivity is concerned, is always uncertain. In summer, kept from five to ten days, it was usually most active; after a longer time its power diminished; and in winter (and this was not due to the temperature at which it was kept) it never became infective at all, the experiments being uniformly. Whenever it was active, and then only, an organism was present, peculiar in its microscopic appearance and its dimensions, so that this form at least of so-called septicæmia must be regarded as the result of infection by a specific germ. This germ may or may not be the cause of pyæmia in man; very likely there are many possessing this property, different species or different forms of the same, and

it may be that at some future time we shall be able to isolate them, and distinguish them from each other as easily as we now can the bacillus of anthrax. All that may be inferred at present is, that in decomposing animal matter there are sometimes present organisms, closely allied to the common forms but not identical with them, capable of acting as the most powerful infective poisons.

It is easy to conjecture from this how surely pyæmia follows on the neglect of any of the ordinary hygienic principles: impure air, defective drainage, unhealthy occupations, overcrowding (particularly if there are at the same time many open suppurating wounds), careless dressings, the use of ward sponges. Everything, in fact, that tends to the accumulation or decomposition of organic matter directly conduces to it. For the same reason it attacks some persons more readily than others, those especially being liable in whom, either from privation or disease of important excretory organs, it may be imagined that the blood is loaded with effete nitrogenous material; and in this way may be explained the well-known predisposing action of the puerperal state, intemperance, fatigue, loss of sleep, mental anxiety, and acute fevers. Children, in spite of the large relative amount of waste material, owing to the activity of their excretory organs, absence of mental disturbance, and ready power of repair, are more exempt than adults, except—and this is very significant—from that form which follows acute suppurative periostitis.

It is even probable, as showing the influence of these predisposing causes, that the tissues of the human body, so long as they are healthy, possess the power of resisting the action of these germs, perhaps even of destroying them. Burdon Sanderson has shown, with regard to the bacteria producing the poison of septic intoxication, that even if they do enter they have no effect on a healthy organism; and this principle may have a much wider range of application, serving, for example, to explain the susceptibility to scarlatina of patients suffering from traumatic fever.

Pyæmia most frequently attacks large foul and sloughing wounds, particularly if there are imperfectly drained cavities, the contents of which are under high tension. The poison germ gains access to the system all the more easily if the protecting barrier of granulations is often disturbed, or if there are large open venous channels such as those of bone, the walls of which cannot collapse; but it may enter through

the smallest puncture, and, under certain conditions, even this is not required. There are at least two disorders, acute suppurative periostitis and ulcerative endocarditis, in which pyæmia, with organisms present in the blood and numerous secondary deposits, frequently develops and proves fatal within a few days, without there ever having been at any time the smallest breach of surface. How the poison enters is not known; it may be through the respiratory or the alimentary tract. But in the light of Burdon Sanderson's observation, it is difficult to avoid the conclusion that somehow or other it does find its way in, and that either the tissues while in a state of health possess the power of preventing its action, or else that it can only develop its energy under certain conditions, of which the effusion of lymph in connection with bone, and the presence of vegetations on the cardiac valves, may be especially favourable. Just as some patients are able to outlive the exceedingly infective germ of malignant pustule, so, unless there is present some condition favourable to its growth, they may be able to live down the scarcely less virulent one of pyæmia; or the germ may not be able to grow unless the soil is ready for it.

The morbid appearances due to the direct action of the poison differ only in degree from those present in septicæmia, the changes being less marked owing to the comparatively slow development of the poison. All the viscera are congested and cedematous, with here and there small extravasations, especially under their serous coverings; the cut surface is not clearly defined, its structure appearing blurred and confused; the interior of the vessels is deeply stained by the hæmoglobin from the broken-down and disintegrated blood corpuscles, and often there are long, partly decolorised heart-clots. But, except for the presence of microscopic organisms in the blood and tissues, there is nothing special in any of these changes—they are common to all cases of blood-poisoning from whatever source.

Nor does the wound, when there is one, present any characteristic appearance; it may, indeed, show no sign of anything wrong, may seem to be healing in a thoroughly satisfactory manner without a trace of suppuration. But more often suppuration sets in, preceding any evidence of systemic poisoning spreading along cellular tissue and tendon-sheaths, and foul and offensive sloughs make their appearance far away from the seat of injury, with dif-

fuse patches of redness on the skin, or long red lines leading up to swollen and tender lymphatic glands; while, if the bone is exposed, the periosteum can be seen drawing away from it, and the coats of the vessels, especially the veins, are thickened and sodden, with coagula, sometimes of great extent, in their interior. These clots, which by breaking up and being carried off into the circulation give rise to some of the most characteristic metastatic deposits of pyæmia, if of recent formation, are simply loose, dark-coloured masses extending, probably, as high as the opening of the next large branch; but gradually, as they become older, the outer layers become firmer and adherent to the walls of the vessels, while the interior slowly breaks down into a puriform fluid, the result of slow caseous degeneration and disintegration. Only exceptionally, when there is some intense irritant retained in the cavity of the vessels, do the leucocytes collect in sufficient number to form a fluid that may really be compared with pus.

When these clots break down, the débris are carried off by the blood-stream until, meeting with arteries too small to allow them to pass, they become impacted. The immediate effect of this differs according to the arrangement of the blood-vessels. If the branch is a terminal one—that is, its area of distribution having no other arterial supply—local anæmia at once sets in, and passes on either to rapid necrosis with suppuration, or else to slow degenerative changes. If, on the other hand, an influx of arterial blood can take place from collateral sources, one of two things will result—either the circulation will be restored and nothing else happen than thrombosis of the small arterial trunk as far back as its last big branch; or else, the supply not being sufficient for this, and only brought by minute arterioles, the blood from all sides will pour into this small territory without strength of current enough to force its way. From this will follow great congestion, and then, owing to the impaired nutrition of the walls of the vessels, diapedesis, until the whole area becomes a firm, solid mass, dark-red in colour and granular in section—a hæmorrhagic infarction. In pyæmia the source of the embolus is infective, so that suppurative inflammation, sometimes even gangrene, at once sets in, whether there has been infarction or not. Only the appearance differs; in the one case, the surrounding purple zone of congestion being much better marked and the suppuration incomplete, consisting rather in the rapid breaking down

of the tissues than in the formation of a large number of pus-cells. Both varieties are met with in the lungs, but previous infarction never takes place in the liver or the subcutaneous tissues.

As a general rule, when the systemic veins are involved, the metastatic deposits are met with in the lungs, and similarly in the liver when the source of the disease is in the range of the portal circulation. But it rarely happens that the abscesses are confined to these viscera, and not seldom it would seem as if the embolus had traversed the first set of capillaries in the order of the circulation without causing any disturbance, and had then set up secondary inflammations in other organs beyond; and it is no real explanation of this, that Weber has found that purulent fluid can be injected into the veins so fine that it will pass through the lungs and be arrested in the systemic circulation, for the distribution of the abscesses in these viscera is not such as can be explained on merely mechanical grounds. Moreover, there are other circumstances that lead one inevitably to the conclusion that thrombosis, and its consequent embolism, can be only one of the agencies which give rise to metastatic deposits in pyæmia. The secondary affections may be rigidly confined to the same class of tissues as that first attacked; the bones alone may suffer, as in some cases of multiple suppurative periostitis, where, following acute necrosis of the shaft of one bone, others become involved later on and with less severity; or the subcutaneous tissues, or the joints, as in chronic pyæmia, and that which follows scarlatina and other acute specific fevers. It may be that, like rheumatism and syphilis, pyæmia has a certain predilection for certain tissues, or that homologous structures are so intimately associated together by their nutritive changes that it is impossible for one to be affected without the others suffering; but it is quite certain that many of the morbid appearances, in the bodies of those who have died of pyæmia, cannot be explained either on the hypothesis of general systemic infection or of impacted emboli.

Thrombosis, with its attendant embolism, originating at a distance from the seat of injury, will account for some of the morbid conditions. Owing to the alteration in the character of the blood and the serious impairment in nutrition of the walls of the vessels and the surrounding tissue-elements, coagulation readily takes place in some of the smaller capillaries, and spreads backwards and forwards for long distances, es-

pecially in those parts of the body in which extensive hypostatic congestion is found *post mortem*. Slight injuries, perhaps never noticed, will account for many more; the vitality of the tissues being lowered to such a degree that a touch, which would not suffice in the healthy body to cause an abrasion, or a puncture with a hypodermic needle, will often cause an abscess. Even a little over-use of a part will set up extensive suppuration; and perhaps this is the reason why the sterno-clavicular articulation, the knee-joint, and the tendon-sheaths around the ankle, are so often involved. So with tissues that have been injured long before and seemingly have recovered completely: fresh mischief lights up again in them as in the residual abscesses round an old diseased joint, or pneumonia in a lung that has once been inflamed. But even when full allowance has been made for all of these, there yet remain many for which no explanation is as yet forthcoming.

Space is too limited to admit of a detailed account of the various lesions found in pyæmia. The reddened patches on the skin, often fugitive during life, of course disappear after death, only a livid staining, with, exceptionally, pustules and superficial abscesses, being left. In the subcutaneous tissue, and extending thence between the muscles, dissecting them from each other, may be extensive collections of pus without limiting walls, and here and there, especially if there has been bruising or undue pressure, extravasations of blood just breaking down, evidently the result of widespread capillary thrombosis. Pleura, pericardium, and peritoneum may all be full of intensely infective fluid, sometimes consequent on embolic abscesses in the walls of neighbouring viscera, sometimes of independent origin. Every organ in the body, but especially the liver, lungs, spleen, and kidneys, may be intensely congested and riddled with abscesses of all sizes, some the result of embolism, and these conical in shape, with their bases towards the surface and perhaps in the centre of an infarction, sometimes more diffuse and irregular in shape and size. Even the brain and the eye do not always escape. Nowhere around these abscesses is there any evidence of repair—there is nothing but destruction, most advanced in the centre and spreading rapidly all round. The great congestion of the alimentary canal, so common in the pyæmia of animals, is not often met with in man. Frequently, the joints or the tendon-sheaths are distended with thin oily pus, greenish from the pressure of broken-down

blood; sometimes only one is affected, more often several, even when it has not been suspected during life. When very recent, the synovial sac and the cartilages show no great change, but soon they become eroded and detached from the bone underneath, while the pus bursts through the softened and yielding capsule, leaving the joint utterly disorganised. Occasionally, in those forms of pyæmia following gonorrhœa, scarlatina, and the puerperal state, the joint is less acutely affected, and if the patient survive, recovers a surprising amount of its usefulness.

Symptoms.—Pyæmia may set in with a sudden and severe rigor, or its commencement may be insidious, with nothing to mark it but an indefinable sense of anxiety and uneasiness on the part of the patient. The wound may show no change, but this, it must be acknowledged, is the exception; more often the stump or the limb, as the case may be, becomes swollen, red, and exceedingly tender, while the surface of the wound is dry, the discharge thin and offensive, and the granulations ashy-grey. Rigors are rarely absent altogether; there may be only one, and then it is usually of extreme severity, or they may occur throughout at intervals of such regularity as to simulate an attack of intermittent fever; sometimes two or three will occur within a few hours, and then there will be a cessation for days. There is no relation between them and the occurrence of metastatic deposits; often the patient is conscious of when they are coming on; the temperature rises rapidly to 106°, or even higher; the skin on the body becomes hot and pungent, while the extremities are livid and cold; there is an expression on the face of the most intense distress, and the sensation of cold is so extreme that the teeth chatter. Then, after an interval of from a few minutes to half an hour, the temperature begins to fall, the blood makes its way to the surface again, and profuse sweating sets in with a feeling of great exhaustion. Even when rigors are not present, the diagnosis of pyæmia can be made from the great irregularity of the temperature, especially if at the same time there are occasional and profuse sweats.

The aspect of the patient soon changes for the worse; at first he may not feel particularly ill, but soon there is visible on his face an expression of peculiar anxiety and apprehension; emaciation is rapid and extreme, particularly when there is much sweating, the features becoming shrunk and withered, and the complexion assuming a

sallow, often icteric tint, and this independently of any secondary mischief in the liver. The eyes are sunken and surrounded by dusky rings; one cheek may have a bright flush on it, particularly if there is any pneumonia; herpetic vesicles, breaking and leaving painful sores, appear on and round the lips, after the rigors; the tongue becomes dry and brown, the teeth and gums covered with sordes, and the breath, and sometimes the patient's whole body, exhales a peculiar sickening, mawkish odour. The pulse is small, irritable, and too frequent; the respiration hurried and shallow; there may be cough, with rusty expectoration, but this is often absent, even when there is extensive pneumonia; more frequently there is great dyspnoea from intrathoracic effusion; vomiting is not usual, except just at the first, nor is there, as a rule, the profuse diarrhœa met with in the case of animals. The poisoned condition of the blood very early shows its effect on the nervous system; wandering delirium, from which the patient can be roused at first, sets in very soon, and becomes continuous; the skin becomes exceedingly sensitive, the slightest touch giving rise to the most excruciating agony, especially over those places where a slight amount of swelling or induration points to the commencement of some deep-seated inflammation; a typhoid state rapidly follows, and ends in unconsciousness and death. Reddened patches make their appearance here and there on the skin, and change their position from day to day; sloughs and bedsores form with the most extraordinary rapidity, extensive areas of skin becoming gangrenous in twenty-four hours. Swellings make their appearance over joints or muscles; at first white and doughy, they rapidly become soft and livid, until either the skin breaks or they are opened; it seems as if whole sheets of connective tissue melted away into pus. If the joint is left unopened, the capsule gives way, and the abscess may first point a long way off.

If the patient should, happily, survive the first infection, and the secondary complications be limited to the extremities, recovery may take place after a long and exhausting illness, with the limbs more or less crippled. When the viscera are involved, the prognosis is even more serious. Death may take place as early as the fourth day, before rigors or secondary deposits have had time to make their appearance; more commonly the patient dies with some visceral complication about the second week, or from exhaustion from prolonged fever and

suppuration later on. In some exceptional cases the disease is even more protracted, rigors, with sweating and other characteristic phenomena, making their appearance after long intervals of comparative good health. Under these conditions, as Paget has pointed out, there is, in general, less severe disturbance of health and less risk to life, especially in the later stages; moreover, the secondary affections are generally limited to one single structure, such as the subcutaneous tissue of the limbs.

Pyæmia most frequently sets in about the second week after operation or injury; but it may commence at any period, and, as it has been mentioned already, may occur without there ever having been an injury at all, the germ entering the system in some other way, and finding an appropriate nidus for its development.

There is rarely any difficulty about the *diagnosis* of pyæmia; in its acute forms the constitutional disturbance is so severe, and the onset of typhoid symptoms so rapid, that here can be no question as to the existence of intense blood-poisoning. It is harder in the case of the joint-affections which occur as complications following gonorrhœa, scarlatina, and some other diseases. That they are due to blood-poisoning in the wider sense of the term there is no question, but it is not easy to say, at present, whether they would come within the stricter definition of pyæmia. Acute periostitis, affecting the lower end of the femur and causing effusion into the knee-joint, is not infrequently mistaken for rheumatic fever until pyæmic symptoms definitely make their appearance; and acute ulcerative endocarditis occasionally presents a somewhat similar difficulty.

From the foregoing it is evident that the *treatment* of pyæmia must be mainly preventive; when it has once set in, we have but slight influence over its course, though, if the patient survive, much may be done by surgery in the treatment of the local affections. It is so much more prevalent in some years than others, independently of any cause known at present, and is so liable to occur as a complication of diseases of the urinary tract and other parts in which it is almost impossible to prevent decomposition taking place, that it is more than doubtful whether it can ever be stamped out; but a great deal may be done to prevent its occurrence. Pure air, especially absence of overcrowding; rigid cleanliness on the part of everyone concerned; avoidance of anything like tension in a wound, by means of drainage or suitable incisions (probably early incision is the only way to prevent pyæmia

in acute periostitis); perfect rest, so that the granulations of a wound are bruised as little as possible; and careful attention to the activity of the chief excreting organs (which are often seriously interfered with when a patient is suddenly confined to bed) are absolutely essential.

When it has once set in, there is little that can be done; if it occur after amputation, consequent on acute osteomyelitis of the stump, disarticulation has been recommended, and might succeed if it could be done sufficiently early, but much more often the osteomyelitis is itself pyæmic. Division of a vein on the cardiac side has also been advised, and may be successful when the mischief is clearly originating there, but such conditions must be altogether exceptional. Quinine in large doses often has a distinct effect on the temperature, and on the severity of the rigors; but the great indication is to husband the patient's strength in every conceivable way, in the hope that he may be able to live down the activity of the germ, and may avoid visceral complications. Local abscesses should be opened early; no good can arise from leaving them, and often when they are opened they are found to be already much more extensive than they appeared to be. Joints that are affected should be treated in the same way, especially if the skin over them shows a fugitive erythema: in the case of the knee in particular, if a free incision is made on either side sufficiently early under antiseptic precautions and drainage-tubes are inserted, the patient will often regain almost perfect movement, especially in the form of pyæmia following parturition. The same treatment has been adopted in the case of the pericardium, but as the inflammation is nearly always consequent on an embolic abscess in the walls of the heart, a favourable result is much less to be expected.

C. MANSELL MOULLIN.

PYELITIS, or inflammation of the pelvis of the kidney, is not common as a primary disease, but is very often met with as secondary to other renal affections. Amongst its exciting causes may be mentioned the use of turpentine, cantharides, or other stimulating diuretics, the presence of calculi or gravel; again, it is not infrequent in the acute specific fevers, such as scarlatina, measles, &c., and is also due in some cases to tubercle deposited on the surface of the pelvis; finally, it may be produced by cold and chill, or may be due to extension of inflammation upwards from the bladder, such as is met with in gonorrhœa.

rhœa. It is met with in both the acute and chronic forms.

The *symptoms* of pyelitis are often masked by those of the condition on which it depends as a secondary affection; but if we confine our attention to those of the local disease in its simplest forms, we shall find them tolerably distinctive. In the acute forms, there is usually pain of a dull aching character in the renal region of the side affected; this is increased on pressure; sometimes it is paroxysmal when obstruction takes place. There is fever in proportion to the severity of the affection, and the rise of temperature is greatest at night, and often very regular as to the time of its appearance. The disease may commence with a rigor. The condition of the urine, however, gives the most important evidence of all. At first there is great frequency of micturition, and the fluid voided is blood-stained, containing mucus and cells (oval, tailed, angular, or rounded) from the renal pelvis, and actual pus-cells besides. Presently, the pus becomes more abundant and regular in its discharge, unless the ureter becomes blocked; in some cases it is intermittent with tolerable regularity. The urine is acid throughout, unless decomposition extend up to the kidney from the bladder. There is often diarrhœa, except when the bowels are pressed upon by an enlargement of the kidney, which is not uncommon where more or less obstruction of the ureter exists. The most characteristic symptoms of all are the presence of abundance of pus and epithelial débris in the urine, with acidity of the latter; tenderness and pain in the loins, and evening fever with no evidence of disease of bladder, prostate, or urethra.

The *prognosis* of pyelitis, if unilateral and simple, is not unfavourable, but if bilateral the condition must always be considered grave. In simple cases which terminate favourably, the congestion gradually diminishes and the pus with it, the subjective symptoms subsiding at the same time. Too often, however, the inflammation in the pelvis is associated with other graver disease, such as interstitial suppurative nephritis, the course of which determines the result; or pyonephrosis supervenes with all its complications. See PYONEPHROSIS.

The *treatment* of pyelitis is essentially the same as that for NEPHRITIS.

ARTHUR E. BARKER.

PYELONEPHRITIS, or inflammation of the pelvis and substance of the kidney, has been so frequently met with associated

with serious surgical conditions of the lower urinary passages, for which operations have been required, as to have been often called 'surgical kidney.' This is an unfortunate misnomer, tending as it does, on the one hand, to suggest that the disease is not met with except as the result of surgical operations, and on the other that, when renal disease supervenes in the course of some condition lower down, it is always necessarily pyelonephritis. Neither of these propositions is true: the disease is often met with independently of surgical operations; and when the latter, or the conditions requiring them, are followed by renal mischief, it is often of a kind quite distinct from pyelonephritis.

If we take a typical case of the affection, its course will be about as follows. Usually, owing to some obstruction to the flow of urine from the bladder, whether it be from stricture, enlarged prostate, villous growth, or other cause, the bladder is kept in a state of chronic distension, and becomes hypertrophied. If the obstruction persist long enough, dilatation of the ureters and pelvis of the kidney is very likely to take place, owing to the pressure of the secretion endeavouring to reach the bladder against the resistance of the hypertrophied organ. And this effort, again, on the part of the kidney is probably a source of some irritation to the parenchyma of the organ, predisposing to, if not actually initiating, inflammatory changes in it. The bladder, further, is predisposed to catarrhal affections by the chronic retention of urine in it. If, now, any acute cystitis is set up, as the result of the introduction of some ferment into the retained fluid (either on a foul instrument or by the spread of decomposition up the traces of urine and mucus remaining in the urethra during the 'overflow' of bad retention, or by other causes), we have almost inevitably a spread of the septic process sooner or later into the dilated ureter and pelvis, and from this into the straight tubes of the gland, already predisposed to inflammation by the prolonged irritation. As a consequence of this, free suppuration and even ulceration is set up in the calyces and pyramids until, in many cases, the latter are almost completely destroyed, and the whole organ is converted into a foul abscess.

The disease is, however, produced in other ways. Thus, the presence of a calculus or calculi may cause ulceration in the calyces, and suppurative inflammation in the substance of the gland. But this cause alone rarely produces the worst forms of the

disease. It may be the result of breaking down of tubercular deposits in the kidney or its pelvis. It may also follow gonorrhoeal inflammation of the urethra and bladder without retention; but in this case, too, destructive inflammation is not often met with.

The appearance of a kidney affected with a considerable amount of acute pyelonephritis is remarkable. The organ may or may not be enlarged; it will in recent cases strip readily out of its capsule, except at certain points at which more or less firm adhesion has taken place. At these spots the colour of the cortex will be altered, and may range from purple to ash-grey or the colour of pus. In the latter case, the consistence of the affected spot will be diminished, or it may even be diffuent. In addition to this, the softer areas are usually somewhat bulged outwards, giving to the whole outline of the organ a peculiar irregularity. On section of the kidney from its great curve to the hilus, each bulged discoloured portion will be found to correspond to a suppurating tract, reaching from the apex of a pyramid to the surface. In many cases the affected pyramids are almost completely destroyed, and the whole organ and its pelvis are converted into a foul, grey, sloughing cavity, more or less crusted with phosphatic deposits.

The *symptoms* are usually severe pain in the loins, aggravated by pressure over the kidney through the abdominal wall. Then there is high fever, especially at night, often ushered in and accompanied by rigors; there are also thirst and anorexia. Objectively, we have a hot flushed skin and an expression of much anxiety, and great frequency of micturition. There may be slight fulness in the renal region, to be felt with the hand. The urine passed is not so abundant as usual, and is loaded with pus, but is still acid in ordinary cases, if taken fresh from the kidney. Often, however, during its sojourn in the bladder, it decomposes, and is passed alkaline. If, however, the bladder be washed out, and then a little of the secretion be collected fresh, it is acid, and may possibly be inoffensive to the sense of smell.

The *treatment* of this condition is by no means satisfactory: still, something can be done. In the first place, all sources of irritation in the lower urinary tract must be removed as far as possible. Obstruction should be relieved as completely, but with as little violence to the parts as may be. The bladder should be washed out carefully with an antiseptic fluid, such as a two-grain

solution of sulphate of quinine or weak Condy's fluid. The loin or loins may be cupped and fomented, if there be much tenderness and check to the secretion of urine. The diet should be very light, consisting chiefly of milk. Quinine should be prescribed internally, and tr. ferri perchlor. Stimulants must be given in very asthenic cases, but should be used cautiously. Complete rest of body and mind should be secured as far as possible, and the surface of the body be kept warm, and protected against alternations of temperature. In certain cases of tubercular disease, or where renal calculi or gonorrhoea are at the root of the condition, it may be proper to perform nephrotomy if the patient's general health be fairly good.

The *prognosis* in cases of double pyelonephritis is extremely bad. In such cases, we usually find the other conditions lower down so severe as to be themselves very dangerous to life, and the additional disease of the kidneys renders them almost necessarily fatal. When one organ alone is suppurating freely there is a better prospect, provided the other conditions are not too far advanced. One kidney may be thus more or less completely destroyed, and, on the inflammation subsiding, nothing but a small mass of cicatricial tissue be left in its place, the opposite kidney taking over the double task, and hypertrophying accordingly.

ARTHUR E. BARKER.

PYLORUS, Operations on the.—In considering this subject it is to be noticed, first, that hitherto these operations have been undertaken chiefly for the removal of neoplasms of the pylorus, usually varieties of carcinoma—i.e. scirrhus, colloid and medullary cancer. They have also been employed in a few cases for other conditions, such as simple ulcer, or stenosis from various causes, or for the establishment of a permanent opening of the duodenum, for the purpose of introducing food in desperate cases of gastric cancer. But, should they be limited to selected cases of malignant disease of the pylorus alone, there is still a large field of usefulness open. Cancer of this part is a comparatively common affection, and as it is a common, so is it a hopeless condition, unless the diseased mass is early removed; and not only so, but the suffering entailed on the patient is most distressing. In the matter of pain there is certainly some variation, little being complained of in certain cases, though in others it is most severe. But, apart from this, there is the distress of

hunger not to be appeased, of distension of the stomach, and, often, of persistent vomiting. At the best we can only look forward to slow, inevitable starvation for our patients, until extreme weakness and perhaps anæmia, due to repeated bleedings from the new growth, put an end to a miserable existence.

It would be foreign to the scope of this article, to enter into the details of diagnosis of disease of the pylorus and the resources of medicine in its palliative treatment. It must be assumed that these points are understood, and that the cases are taken up by the surgeon when the physician admits his powerlessness to do more. This leads us first to the consideration of the operation for removal of the pylorus.

This was first performed on April 9, 1879, by Péan of Paris, whose description of the procedure is too imperfect for the reader to estimate safely the probable cause of its want of success. It was next performed by Rydygier of Culm on clearly defined principles, but the patient succumbed from shock twelve hours after the operation. Billroth followed next with a success in the case of a woman of forty-three, who was alive and well some months after. The next two operations were also performed by Billroth, but both patients died from their effects. Then comes a most successful case by Woelfler, whose patient was alive and well four years afterwards. Since then, the operation has been done many times, with varying results, by several Continental surgeons. In this country but little has been attempted in this direction, the only three cases recorded having proved fatal, and we are obliged to turn to the German surgeons for statistics of the procedure so far. Thus, Billroth and his assistants have removed the pylorus eighteen times with ten deaths, Gussenbauer five times with four deaths, Rydygier five times with two deaths, Czerny four times with two deaths. On the whole, up to August 1885, the pylorus has been resected at least 82 times, according to Kramer. Of these 72 suffered from carcinoma, the rest from stenosis—the result of ulcer of the pylorus. Of the first 72, 55 died; 17 recovered; and among the remaining 10 we find 4 recoveries and 6 deaths. These statistics teach but little, except so far as the results in the hands of individual operators can be compared. They are introduced here as indicating the extent to which this branch of surgery has already developed, and as generally suggestive of the gravity of the procedure.

But though a most formidable operation, both on account of the difficulty of its performance and the high rate of mortality which has hitherto attended it, it has been justified on the following grounds:—First, the inevitably fatal character of the disease for which it is undertaken, and the suffering entailed thereby. Secondly, the disease, if cancerous, remains for a long time localised to the immediate neighbourhood of the pylorus. Thus, out of 542 cases dying of cancer of this part, 223 had no secondary deposits anywhere. Thirdly, it is slow to contract adhesions to adjacent parts. Finally, it has been shown, by post-mortem examination of a large number of cases dying of malignant disease here, that it does not commonly extend to the duodenum or neighbouring glands before it has produced fatal stenosis.

Admitting, then, that for certain patients, and in the hands of skilled surgeons, this operation is justifiable as holding out a sufficiently good prospect of temporary and perhaps permanent relief, we have briefly to consider the selection of cases and the preliminary preparations necessary before operation.

In the first place, the patient's age is a matter of more importance here than elsewhere, in view of the length of the operation and the vital region in which it is performed. The same may be said of the general health. Old and weakly individuals, therefore, should not be subjected to the risk, and, with younger people, their general state should be good to justify the operation; which is as much as to say that, if anything is to be done for them, they should not be allowed to run down to the last stage of weakness before the surgeon is asked to interfere. The subjective and objective symptoms should be distinct, and especially the tumour, which, moreover, should be freely movable in all directions—i.e. without adhesions to surrounding parts. Slight adhesion to the abdominal wall may not, perhaps, quite contra-indicate the operation in cases otherwise favourable, inasmuch as the adherent portion of the parietes may be excised with the growth. Cases, again, in which there is great chronic dilatation of the stomach, appear unsuitable for operation, unless the condition can be overcome by preliminary treatment. A dilated stomach, after such an operation, almost inevitably assumes a position in which its walls act like a valve to the new opening, and prevent all passage of food through it, as in Billroth's second case.

All these points should be closely examined into with the help of careful palpation of the abdomen under chloroform; and in cases in which there may be doubt on one point or another, but which appear generally suited for operation, an exploratory incision through the abdominal wall is quite justifiable, in order to examine the relations and condition of the growth with perfect accuracy. If these things appear in closer inspection to contra-indicate interference, this opening may be closed without further action.

When it is decided in any given case to proceed to excision of the pylorus, certain preliminary measures have been shown by experience to contribute to a favourable result. Among these, the careful washing out of the stomach with tepid water stands first in importance. This is effected by means of an ordinary soft rubber tube passed into the stomach, and attached to a funnel at the other end. Through this about a quart of tepid water is passed into the organ, and then allowed to syphon out again with the funnel held at a lower level. This is repeated over and over again, until the water returns clear. This treatment should be begun several days before operation, and should be done two or three times each day, and finally, about an hour before the operation is begun, the organ should be washed out with a solution of salicylic acid in water (1 in 1,000). It is an extremely unpleasant procedure for the patient at first, but is better tolerated with practice. In view of the gravity of the operation, neither it nor any other detail necessary for the absolute cleanliness of the field of action should be omitted. The bowels should also be carefully unloaded by means of high-reaching enemata, repeated two or three days beforehand.

As to the operation itself, it is first necessary to remark that the position of a cancerous pylorus may vary greatly. It has been found to the right or left of the umbilicus, and even as low down as Poupart's ligament or the symphysis pubis. The position of the ventral incision will therefore vary accordingly, but it usually lies between the navel and the margin of the ribs, and parallel to the latter on either side. Some operators however prefer the linea alba above the umbilicus. The direction, in the first case, will be modified more or less by the exact situation of the diseased mass, which is the real determining consideration. The incision in the abdominal wall is made layer by layer, until the serous lining is reached, but the

latter is not divided until all bleeding is completely arrested. In severing the attachments of the diseased mass, both the greater and lesser omenta are divided, but always to as small an extent laterally as possible. One of the greatest dangers after operation is sloughing, either of the gastric or duodenal margins of the united wound, or of the walls of the colon, due to disturbance of nutrition or innervation as the result of damage to the greater or lesser omenta, and this has to be guarded against by every means possible. Every effort should also be made to spare the pyloric, gastro-duodenal and gastro-epiploica dextra arteries and their branches, consistently with the thorough removal of the growth, and any glands in the neighbourhood which may excite suspicion. In dividing the stomach and duodenum, bold strokes should be made with a very sharp scissors, to ensure even-cut edges suitable for accurate apposition. Various clamps have been suggested, from time to time, to fix the borders of the viscera during the stage of stitching; but if Woelfler's suggestion (see below) be adopted—i.e. to divide each viscus only partially, and unite the portions thus divided before proceeding to complete the excision—nothing of the kind will be required.

Operation.—In an ordinary case, in which the pylorus maintains very nearly its normal position, an oblique incision is made parallel with the right costal margin, and between this and the navel. This incision should be about 11 centimètres long, = $4\frac{1}{2}$ inches, about one-third of it being to the left of the linea alba. If the tumour be to the left of the middle line, a corresponding incision is made parallel with the left costal border. Either of these gives much freer access to the affected region than the incision in the linea alba, practised in several cases. At first the knife is only carried as far as the peritoneal lining, without dividing it, and before the membrane is opened, every bleeding point is controlled until the wound is dry. Then the serous lining is divided, the cavity of the abdomen opened, and a most careful examination of the condition of the pylorus is made. For the present, at all events, it is well to adopt the rule that extension of the growth either to the colon, the pancreas, or the duodenum, contra-indicates completion of the operation; and if such complications exist, further exploration should cease and the abdominal cavity be closed, unless digital dilatation of the pylorus be considered justifiable (*vide infra*).

But where the growth is limited to the immediate neighbourhood of the pylorus and lesser curvature of the stomach, we proceed by drawing it, with a broad many-toothed vulsellum-forceps, as far as possible out of the parietal wound, and commencing its isolation. First, the omentum is separated for a certain limited distance along the greater curvature of the stomach, having been tied in small portions and divided between the ligatures. Then the lesser omentum is similarly severed, but also to as limited an extent as possible. All this time the exposed viscus is covered with thoroughly aseptic napkins, wrung out of warm carbolic or salicylic acid solution. When fully isolated above and below, a napkin or flat sponge is slipped under the diseased portion, and this protects the abdominal cavity from the entrance of blood or fluids from stomach or duodenum, when divided. The removal of the growth and subsequent union of the cut edges is, consequently, practically an extra-peritoneal operation. One of the most difficult problems presented by the whole procedure now offers itself—namely, how to divide the sound tissues on either side of the growth, so that the very much larger lumen of the stomachal opening may be best adapted to the smaller duodenal one, and how best to unite them. This is done in various ways, according to the shape of the growth. The mode now described is that followed by Billroth in his later cases, and embodies slight modifications of the method pursued in his first successful one. These modifications had shown themselves to be of great value first in the hands of Woelfler, from whom they emanated.

In the smaller end of the stomach an incision is first made with one or two bold, steady strokes of a scissors downwards and obliquely from left to right, dividing both sides of the organ at once, but only for about two-thirds of its depth. This incision will lie about three-quarters of an inch from the limits of the growth, and in sound tissue. The stomach is now freely opened above, but is still attached to the pylorus below. The edges of the stomachal wound are now brought carefully together with a double row of stitches, according to Czerny's method. This consists in introducing first one row of fine carbolic silk threads, dipping through the serous and muscular coats of the organ at about a quarter of an inch from either edge of the wound in its walls, and coming out on the cut surfaces without including the mucous coat. When drawn tight, the

edges are brought together by their serous surfaces alone. These threads are set apart about a tenth or an eighth of an inch apart from one another, and when tied are cut short at once. They are then succeeded by a second row a little farther off from the edge of the wound, each stitch lying opposite an interval between those of the first row, and entering and leaving the serous and muscular coat without including the mucosa. These are not cut short at present, as they serve to hold the stomach steady after its complete division. This is now done with the scissors as before, and the resulting opening ought now to correspond in size with the lumen of the duodenum. The latter is now half cut through from above with the scissors, by one bold stroke passing obliquely from left to right as in the case of the stomach, and clearing the border of the growth by about three-quarters of an inch.

Steadying the duodenum by the still attached mass held in a vulsellum-forceps and the stomach by the ends of the 'occlusion sutures' not yet cut short, the operator now stitches the upper divided portion of the duodenum to the upper part of the reduced orifice in the stomach. The stitches here may be introduced as in the case of the stomach, or may be begun on the inner aspect of the bowel for its posterior third, by thrusting the needle between the mucous and muscular coats, then through the latter and the serous then through the serous and muscular coats of the opposite border, and so on to the edge of the second cut surface again where the thread is tied. The knot in this case lies within the bowel instead of between the serous surfaces, but the effect is the same as far as the apposition of the latter is concerned. This mode of suturing the ends is only applicable to about the posterior third of the circumference of the bowel. When this has been accurately united to the border of the stomach, the remaining half of the duodenum is severed and the growth is now completely removed. The rest of the stitching is now finished with the Czerny suture, as above described, introduced from the serous aspect. The two cut ends of the bowel are now accurately united on their serous aspect, and should be quite water-tight if sufficient care has been taken to place the stitches at equal distances and to tie them evenly. The partial division of the viscera, just described, may be done either from above or below, according to the shape of the growth, but the former method has been found to give the best

result as to the future shape of the stomach. In either case, the reduction in size of the stomachal opening by stitching (*Occlusions-naht*) precedes the further steps of the operation. It is almost needless to remark that, throughout the whole procedure, the field of operation must be constantly cleansed from blood and the visceral secretions with soft carbolised sponges, besides being protected from every chill; all bleeding, too, must be at once arrested with clip-forceps.

The subsequent steps of the procedure are simple. After a final cleansing of the whole field of operation, the united ends of the viscera are carefully replaced in the abdomen, and adjusted so as to favour the directness of the opening of the stomach into the duodenum; then, the abdominal cavity is closed in the usual manner, so as to bring the serous surfaces of the parietes into contact with one another.

The *after-treatment* of the patient is often a matter of much difficulty. A careful study of the articles of diet best borne by the stomach before operation is of the greatest importance. At first some easily digested fluid is given, iced and in very small quantities, while peptonised and alcoholic enemata are administered at regular intervals. Then, by degrees, there is a cautious return to the ordinary articles of diet. Opium may be required, but should not be given unless urgently called for, as it may produce nausea or even vomiting, which would be most injurious. In some of the successful cases it is remarkable how little interruption there was to complete and rapid recovery; in one (Woelfler's), the patient was able to eat meat from the tenth day onwards, and in Billroth's first case, a beef-steak was eaten on the twenty-first day with no ill effect.

Several variations in the method of suturing the bowel might be mentioned here, but the writer has thought it wiser to describe what may be taken as the typical method only, lest any confusion should arise. In addition to the last-mentioned operation of pylorotomy, another has to be mentioned here which will probably take its place in the future, in many cases of disease of this part.

DIGITAL DILATATION OF THE PYLORUS is an operation designed and practised first by Prof. Loreta of Bologna, in September, 1882. Hitherto it has been employed only in cases of non-malignant stenosis, and here it appears to have done good service. The operation consists in cutting down upon the pyloric end of the stomach,

with all the preliminary precautions mentioned as necessary for pylorotomy, drawing a portion of the viscus into the parietal wound, and incising it sufficiently to admit the forefinger. The latter is then thrust with a rotatory motion through the narrowed pylorus, dilating as it goes; then, the left forefinger is similarly insinuated along the first, and both are separated until a dilatation of three inches has been effected. The stomach wound now is sutured in the usual way, and then (with due care as to cleansing the parts around) the abdomen is closed.

So far, this operation has been performed six times. Three of the patients recovered and were much benefited, in a fourth the result is doubtful, while two died as the result of the operation. The time consumed in the whole procedure compares very favourably with the records of other operations in this region. In Loreta's four cases the average duration was under thirty-three minutes, the longest fifty minutes.

GASTRO-ENTEROSTOMY is an operation which was first performed by Woelfler in September, 1881, as an alternative to pylorotomy in certain cases. Indeed, it appears not improbable that it may supplant the latter measure to a large extent, in view of the great tendency to recurrence after excision of the pylorus and its great risks, the newer operation giving much relief and being easier of performance and far less dangerous, although of course only palliative. Without entering further into this question here, the operation may now be briefly described.

In the first place its object is to establish an opening between the stomach and small intestine, as high up in the latter as possible, in order that the contents of the former may find their way through the digestive tract, hitherto blocked by the disease of the pylorus. If this opening is once established, the food leaving the stomach becomes mixed with the secretions of both liver and pancreas in the bowel, and the processes of digestion and assimilation are performed as usual, the patient being much relieved until generalisation of the disease, if malignant, terminates life. If, on the other hand, the operation is performed on account of chronic ulcer of the pylorus, with or without stenosis, the rest given to the part, and the improvement in general nutrition, may lead to repair and cure of the condition.

The preparations for the operation are identical with those for pylorotomy, described above. The same may be said of the incisions until the stomach is reached.

From this point the procedure is very simple. First, the stomach-wall is drawn out of the wound and so held. Then, a loop of small intestine is caught as near to the duodenum as possible and also made to protrude from the abdominal opening. Here, it is emptied of its contents by being passed through the fingers, and is kept so by two ligatures passed through its mesentery on either side of the emptied portion and tied lightly. It is then incised along its free border for an inch and a half, and this wound is carefully cleansed. A corresponding opening is made towards the pyloric end of the stomach at some small distance above its great curvature, so as to avoid the larger vessels. When all bleeding has been controlled and the parts cleansed perfectly, the two openings are united on their serous surfaces by Czerny's suture in the usual way, the posterior edges being stitched first. To avoid a possible 'kink' in the intestine at the point united to the stomach, it is well to stitch the bowel to the latter for about an inch or so beyond either end of the orifice, in the same way. Nothing now remains but to cleanse the whole field of operation, and to close and dress the abdominal wound in the usual manner.

DUODENOSTOMY, or the formation of a permanent artificial opening into the duodenum through the abdominal wall, is another alternative to pylorotomy, which need only be briefly mentioned to be condemned. It has been performed three times in desperate cases of cancer of the pylorus, but has proved fatal in each. It is hard to see any grounds for its justification, especially since in gastro-enterostomy we possess an operation as easy of performance, not more dangerous, and which re-establishes the communication between the stomach and small intestine so that the patient may be fed in the usual manner by the mouth.

The operation consists in cutting down upon the pylorus in the way mentioned above, then drawing the anterior wall of the duodenum into the wound and stitching it there by its serous and muscular coats alone, as in gastrotomy. When adhesion has taken place all around after a day or two, the bowel is opened and the patient is fed through the orifice.

In **JEJUNOSTOMY**, which has lately been brought under notice, we have another alternative to pylorotomy. It has the advantage over duodenostomy that it is easier to perform in every way. But, beyond this, it is difficult to see how it is likely to come much into use so long as we

have gastro-enterostomy to replace it. In the report of an interesting case brought before the Clinical Society by Mr. Golding Bird, in November, 1885, the method of procedure was detailed, as well as some recommendations for the after-treatment of the patient; and, in the debate which followed the reading of this case, the whole question was fully discussed. But though the patient did not die as the result of the operation, but in consequence of a regrettable accident, the impression left upon the mind of the writer is that the operation has little to recommend it, so long as gastro-enterostomy gives such promising results as hitherto in the very distressing class of cases in which it is employed. The mode of operating for jejunosomy is essentially the same as that for duodenostomy just described, except that a coil of the jejunum is opened instead of the duodenum.

ARTHUR E. BARKER.

PYONEPHROSIS, or the distension of the pelvis and body of the kidney with pus, is a common affection. Like hydronephrosis, it is usually unilateral. In the mechanism of its production, too, it resembles the latter condition in many ways, with the element of inflammation superadded. This inflammation presents itself in one or other of the many forms of **PYELITIS**. Again, a hydronephrosis may be converted into a purulent collection by injury, such as a strain or blow upon the sac, or after puncture for its evacuation. Further, a penetrating or contused wound of the kidney may lead to the formation of pyonephrosis.

The *objective symptoms* are almost identical with those of **HYDRONEPHROSIS**, and need not be separately described. It has been noted, however, that though the latter may enlarge until it has transgressed the middle line of the body, such is never the case with the purulent collection. An examination, too, of the urine will often furnish extra evidence. Thus, we are, in many cases, able in this disease to demonstrate pus in it, when there is no evidence of any morbid condition in bladder or urethra. Such pus is met with in acid urine, and is not usually constant in amount. Indeed, on some occasions it is entirely absent, often to re-appear suddenly in abundance, with perhaps some relief to the general symptoms of distension, but with increased frequency of micturition.

The *subjective symptoms* here are those again of hydronephrosis, with, in addition, some rise of temperature in many cases.

This is usually regular in its appearance very evening, the morning temperature being normal as a rule. In some cases, however, where renal colic accompanies the onset of the condition, there may be a rigor with general febrile disturbance. But the diagnosis between hydro- and pyonephrosis is always made quite easy by incision and aspiration with a fine needle, a procedure easily carried out and destitute of risk, if performed on the lines already laid down under HYDRONEPHROSIS.

The treatment of pyonephrosis is not always the same. Aspiration, often repeated, may be at last successful in relieving the tension, but is very rarely so. It is justifiable, too, that it may give rise to further complications if not employed with great care. Thus, septic matter may be introduced into the sac, with the consequent abscesses, or again, the sac, being frequently perforated by the needle, may yield at one point in spot and the pus escape into the perinephral tissues, so forming a lumbar perinephral or a psoas abscess.

The best treatment for ordinary cases is in doubt, in the first place, free antiseptic drainage at the point of election behind. See NEPHROTOMY. If this does not result in the final shrinking and closure of the sac, and the patient suffer much from the prolonged discharge with its attendant discomfort and risks, which are often great, NEPHRECTOMY should be resorted to. It should not be forgotten, too, that prolonged suppuration here may lead to amyloid change in the internal viscera; and that a change of that kind affecting the opposite kidney would, in this case, be more usually grave, in view of the damaged condition or perhaps complete destruction of its fellow. But besides this, the opposite kidney may, in some cases, be damaged by a reflex irritation due to the passage of pus from the diseased side through the bladder, when the drainage through the ureter has released the obstruction to the bladder, as it sometimes does. As this pus, in spite of every precaution, often becomes collected in the sac, during the months through which the renal fistula discharges while the patient is up and about, we need not be surprised to find that it produces cystitis in some cases, and the secondary changes just referred to in the opposite kidney, which has hitherto been quite sound. This is a strong argument against allowing a pyonephrosis to remain too long through the loin. If there is evidence that the other kidney can do the work of the economy, and the patient's general condition do not contra-indicate it, VOL. II.

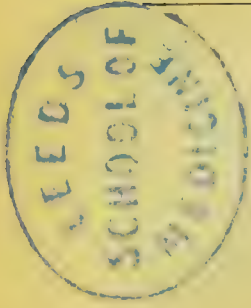
nephrectomy will be the proper treatment in many cases.

In the *prognosis* of pyonephrosis we have to consider the immediate prospects of the patient, and the remote. The first varies much with the cause of the purulent accumulation. If it have formed slowly—e.g. from the gradual closure of the ureter due to inflammation of the pelvis—the immediate outlook is not grave. The collection may only give rise to distress from its bulk, and, until this becomes extreme, little is complained of, and the febrile disturbance may be but moderate. But when the condition is caused by the sudden blocking of the ureter of a kidney actually suppurating, there is rapid distension, with far greater disturbance of the parts around, and this, with the usually greater fever, is a distinct source of danger calling for speedy treatment. Eventually, the remote dangers in both instances are the same. First among these is rupture of the sac, with outpouring of its pus. If this take place into the peritoneal cavity, the result is a necessarily fatal peritonitis. Fatal empyema is also occasionally produced by bursting of the sac into the thorax, or abscess of the lung, but recovery has been seen even after these complications. Less dangerous, but still formidable, is rupture of the sac into the adherent colon or small intestine, with the thorough evacuation of the pus, but most probably with acute inflammation of the bowel sooner or later. If the collection burst into the perinephral tissues the pus may rapidly form a large extra-renal collection, which again may rupture in various directions. See PERINEPHRITIC ABSCESS. The most favourable termination of all is very rarely seen—namely, the giving way of the obstruction and permanent drainage of the pus into the bladder, or the ulceration of the sac into the ureter itself at a point low down, where it is expanded and flattened out, being pressed upon by the tumour; in either of these ways a spontaneous cure may be brought about, but the chance of such an event is exceedingly remote.

But, without rupture in any of these directions, a pyonephrosis may become dangerous from its gradual enlargement, with pressure upon important parts, and interference with their functions. This, together with the consequent fever, often gradually leads to a state of marasmus, which eventually terminates the patient's life.

ARTHUR E. BARKER.

PYO-SALPINX—Pus in the Fallopian Tube. See FALLOPIAN TUBES, Diseases of the.



Q

QUILLED SUTURE. *See* SUTURES.

QUININE, Eruptions from. *See* MEDICINAL ERUPTIONS.

QUINSY. *See* TONSILS, Diseases of the; PHARYNX, Diseases of the.

R

RABIES. *See* HYDROPHOBIA.

RADIAL ARTERY, The.—I. *In the Forearm*: from opposite the neck of the radius to the styloid process of the radius. The artery runs down superficially for most of its course, but overlapped above by the supinator longus muscle.

In front are the cutaneous structures only, but the supinator longus overlaps it above. *Behind*, it rests on the tendon of the biceps, the supinator brevis, the pronator radii teres, the flexor sublimis, the flexor longus pollicis, the pronator quadratus, and the radius. The radial nerve approaches it on the outer side in the middle third of its course. Venæ comites accompany it.

LIGATION.—1. In the upper third: Support the limb in the position of abduction, with the forearm supinated. Make an incision in the line of the artery, two inches long, avoiding the cutaneous veins. Cut through the cutaneous structures, and find beneath the deep fascia the inner free edge of the supinator longus; flex the forearm slightly, draw the relaxed supinator longus outwards, expose the artery, and, after separating the venæ comites, pass the needle from without inwards.

2. In the lower third: Place the arm and forearm as before. Make an incision in the guiding line of the artery, or on the radial side of the flexor carpi radialis, for a distance of two inches, ending not lower than one inch above the wrist. Cut through the cutaneous structures, raise the deep fascia on a director and incise it, find the artery and, after separating the venæ comites, pass the needle from without inwards.

3. In the middle third: The radial nerve is found on the radial side of the artery; hence care must be taken to avoid it.

II. *At the Wrist.*—The radial artery lies in the front of the forearm, and passing downwards below the level of the styloid

process of the radius, it winds backward beneath the three extensor tendons of the thumb, to reach the palm of the hand between the first and second metacarpal bones. In this course it can be felt, and could be tied, between the extensor primus and extensor secundi internodii pollicis tendons. JAMES CANTLIE.

RADIUS, Dislocation of the.—The head of the radius may be displaced in three directions—viz. *forwards, backward or outwards.*

DISLOCATION FORWARDS is the most frequent, and it may be partial or complete. Usually, it is caused by a fall on the palm, occasionally by a direct blow or fall on the outer and back part of the elbow, and in children by dragging them by the arm. The writer saw, in 1880, a partial dislocation forwards, caused by a nursemaid angrily dragging a crying child up stairs to bed, when the parents were out. The *symptoms* are semi-pronation and inability to flex the arm beyond a right angle, owing to the head impinging against the front of the humerus. During extension the head comes forward, and can be felt, and often seen beneath the skin, whilst behind and below the external condyle, a depression may be felt in the situation from which the bone has been displaced. Much difficulty has occasionally occurred in reducing this dislocation, owing perhaps to a portion of the orbicular ligament intervening, but more often the bone may be reduced with ease, and then has a tendency to relaxation. Reduction is to be effected by extension at the wrist, whilst the thumb is pressed on the head, followed by flexion. Afterwards, the limb should be put up in a rectangular anterior splint, and, if there is a tendency to relaxation, this position should be maintained for a month or six weeks, and then passive motion be gradually commenced. In cases where the dislocation has remained unreduced, a ne-

joint is formed in front of the humerus, the head of the radius becomes partially absorbed, and the power of flexion gradually decreases.

An injury produced by dragging young children by the arm, causing pain, protraction and semiflexion, has attracted the attention of several surgeons, and doubt has been expressed whether the injury was at the elbow or wrist, Goyrand having suggested that it was due to displacement of the triangular cartilage in front of the carpal extremity of the ulna. J. H. Hutchinson, in experiments recently undertaken upon the bodies of infants, has found that, under strong traction during supination, the head of the radius slips below the orbicular ligament, and that semiflexion and protraction will cause the ligament to assume its natural position, with a click. This displacement of the orbicular ligament, he believes to be the lesion usually present in these sprains.

DISLOCATION BACKWARDS comes next in point of frequency. It may be caused when the arm falls on the palm when the forearm is only pronated, by direct injury to the joint of the arm, or by twisting the forearm into a state of over-pronation. The forearm is semiflexed and pronated; supination and flexion are painful; the head of the bone may be seen and felt behind the external condyle; and a depression can be felt below the external condyle, whence it has escaped. Fracture of the external condyle is sometimes a complication. Reduction should be effected by extension and pressure, after which a rectangular splint should be applied, and a pad pressed over the back of the head of the radius. During extension the head is liable to be relaxed. W. Allen has related a case where, as a result of backward dislocation in early life, the head of the radius released from pressure grew one-quarter of an inch, and the external condyle half an inch.

DISLOCATION OUTWARDS is very uncommon, and, according to Hamilton, is secondary to dislocation forwards. The head projects beyond the external condyle, and is felt to rotate during pronation and supination. It should be pressed into place during extension, and a rectangular splint afterwards used, with a pad to keep the head from again slipping out.

R. CLEMENT LUCAS.

RADIUS, Fracture of the.—Fractures of this bone, unassociated with fracture of the ulna, are, if we exclude Colles's fracture,

rare. They may, however, occur through the neck, shaft, or lower end.

Fracture of the *neck* is much more rare than some have believed; yet there are now many instances on record in which it has been proved by dissection. The writer has recorded an instance in which, during an operation for the removal of the upper end of the radius in what seemed to be a case of old unreduced dislocation of the head forward, locking the joint, he found the real condition to be that of comminuted fracture of the head and neck of the bone, with large heaping up of callus between it and the ulna. In a second case, that of a little girl aged ten, the daughter of a surgeon, there was, after she had fallen upon the hand, very plainly marked crepitus, apparently close beneath the skin, and at the junction of the neck with the shaft of the radius; and no movement of the head of the bone occurred when the shaft was freely rotated. There was no displacement. All the symptoms disappeared at the end of a month, during which the arm had been kept in a rectangular splint. There was no loss of movement.

The *symptoms* of fracture of the neck of the radius are non-movement of the head when the shaft is rotated; preternatural mobility of the upper fragment when grasped between the finger and thumb; crepitus and pain on attempted supination. In the first of the two cases related above, the injury presented all the appearances of dislocation of the head of the radius. The only *treatment* required is the use of a rectangular splint for the arm and forearm, to maintain rest. Passive movement should be commenced at the end of three weeks, to be, of course very gently, used till union is firm, and steadily employed while stiffness remains.

When fracture occurs at any point between the insertions of the biceps and the pronator teres, the upper fragment, as Mr. Lonsdale has pointed out, will tend, under the action of the biceps (and, it may be added, of the supinator brevis), to be strongly supinated, while the lower will be left entirely to the pronators. Should union in this position be allowed to occur, even though the fragments are placed end to end, the rotation of the one or the other will entail complete loss of the movement of supination. To avoid such a result, the limb, in this particular fracture, must be placed in a position of supination on a rectangular splint, applied to the posterior or dorsal aspect of the arm and forearm. Passive movement of pronation and supina-

tion should be commenced in about a month, and the splints may at the same time be discontinued, the arm, however, being kept in a sling.

Fracture of the radius and ulna together is of frequent occurrence at all ages, but especially in children, in whom it results from falls on the limb. In adults, it is generally the result of direct violence, as by the passage of a wheel, or by a heavy blow. Malgaigne records a case in which it was caused by muscular action (while the patient was digging). The fracture is most often seen at the junction of the middle with the lower third of the bones, or above this point. The bones are usually broken transversely, and at the same level; but the radius may give away a little higher up than the ulna. In children, in whom the fracture is often incomplete (greenstick), displacement is very slight, or may present itself as a mere bend, not easily observed in the fat limbs of infants. Thus, care must be taken that this injury is not overlooked. In adults, considerable riding of the ends may occur when the fracture is oblique. The nature of the injury is generally indicated by deformity, mobility, and crepitus.

It is difficult to secure a good result after this fracture, on account of the strong tendency that exists to displacement by the supinators and pronators of the forearm, as described above. To prevent this, the limb should be fixed in a position of supination on a rectangular splint, applied to the posterior aspect of the arm and forearm; and, for an extra precaution, a short anterior splint should be applied to the forearm, with a narrow pad placed over the interosseous space to maintain, as far as possible, the proper interval between the bones. The limb must be supported in a firm sling. In adults, movements of supination and pronation should be gently employed every other day or according to circumstances, at the end of a month; but the dorsal splint should be continued, so as to maintain supination, for at least five weeks. In children the period of treatment may generally be reduced to three weeks.

Fracture of the radius and ulna, at their *inferior extremities*, is occasionally seen. The nature of the injury is usually clearly indicated by mobility and crepitus, and the tendency for the deformity to return when extension is discontinued; but when the fracture is within an inch of the articular surfaces, the aspect of the limb may very closely resemble that of dislocation of the carpus backwards. The latter accident,

however, is extremely rare. In fracture, moreover, it will be found that the styloid processes of the radius and ulna are displaced with the hand, while in dislocation they occupy their normal relation to the shaft of their respective bones.

Treatment consists, after careful adjustment, in the use of straight dorsal and palmar splints, as recommended for Colles's fracture.

Fracture of the *lower extremity* of the radius—*Colles's fracture*. The lower end of the radius is more often broken than any other part of the skeleton, except the clavicle. Though expanded to articulate with the carpus and carry the hand, this part of the bone is of no great strength for it is formed, except for a compact layer on the surface, entirely of cancellous tissue and this in the old, in whom the fracture is very common, acquires a very open texture in consequence of the partial absorption of its trabeculae. Though occasionally, either alone or in conjunction with fracture of the ulna, the result of direct violence, this injury is in the great majority of cases produced by falls on the hand.

The fracture is generally transverse, but occasionally it is oblique from side to side. It is usually situated at some point within an inch of the articular surface; but the size of the lower fragment is subject to much variety. It may be a mere plate, while sometimes, though rarely, it measures an inch and a half from above downwards and between these extremes all gradations are met with. In some instances displacement is very slight, but most commonly the lower fragment is carried backwards with the carpus, and rotated on its transverse axis, so that its articular surface acquires a certain amount of inclination upwards, instead of looking, as it should, directly forwards; it is also displaced more or less laterally, so that the projection of the styloid process towards the radial side is increased. This complicated displacement produces a very characteristic deformity, best seen when the forearm is raised in the horizontal position to the level of the eye and looked at in profile.

The lower fragment, carpus, and neighbouring part of the hand form a considerable prominence on the dorsal aspect sloping downwards towards the metacarpus, while immediately above is a well marked hollow; on the palmar surface just above the wrist, is a projection formed by the end of the upper fragment, while the level of the wrist itself is a depression corresponding with the dorsal prominence.

thus the shape of the limb is somewhat like that of an inverted spoon. In many cases the hand is inclined towards the radial side, and appears to have dropped away from the styloid process of the ulna, which becomes very prominent. The deformity, as R. W. Smith maintains, depends doubt in some cases on muscular action, the effect of which is clearly seen in the production of the displacement, when, after adjustment, the parts are again left free from restraint. But very often—that is, probably in more than half the cases—is due to the fact that the force applied to the bone has been sufficient not only to fracture it, but to drive the posterior part of the upper fragment into the cancellous tissue of the lower, so that the fracture is impacted.

Other symptoms of the injury are severe pain, and inability on the part of the patient to move the wrist. In some instances, there is mobility of the fragments on each other with crepitus. The opportunity, if occurs, of making a complete examination before swelling has supervened to secure the features of the case, should on account be neglected. Plain as its existence often is, this fracture is sometimes little marked, that it may be, and in fact it rarely is, overlooked. It should be noted that fracture of the lower end of the radius is said by R. W. Smith to occur in adults on the back of the hand, the lower fragment being in that case displaced forwards; but the present writer knows of no specimen which illustrates this condition. In young subjects (under the age of twenty) separation of the epiphysis not rarely takes the place of fracture. In many cases the lower fragment is extensively comminuted, the fracture entering the wrist-joint.

Treatment.—Readjustment is often difficult: sometimes because the fracture is only impacted, in other instances because the lower fragment is small and cannot easily be grasped, or is broken into several displaced pieces; in others, again, from the condition of the tendons. The method most likely to succeed in effecting reduction consists of extension while the hand is supinated and adducted, combined with direct manipulation of the fragments; the direction in which extension is made may be varied according to the case. Though considerable force may be used, it should not be carried to the point of violence, for, after all, extension of the hand does not act very directly on the lower fragment, as no very strong connection exists between these parts, while such

as should be present have been more or less lacerated by the injury. Moderate extension, combined with pressure on the fragments in a direction the reverse of that in which they are locked together, will generally secure the best attainable result. Should reduction not be accomplished on the first trial, the attempt should be repeated a week later, when the fragments may have become somewhat loosened on each other, and when, swelling having subsided, manipulation can be more accurately directed.

Numerous different splints have been recommended for Colles's fracture. Many surgeons prefer the pistol-shaped splint, placed on the dorsal aspect of the forearm and hand, so that the latter is carried towards the ulnar side, and the lower fragment is drawn in the direction opposite to that of its displacement. Often, a short splint is at the same time applied to the palmar surface of the forearm, and is padded so as to take effect on the radius a little above the fracture, and press the upper fragment backwards. Others use the pistol splint on the palmar, and the short splint on the dorsal aspect. Carr's (American) is a palmar, trough-like splint, curved to the shape of the limb, and appended to this a hand-block, over which the palm rests in an easy position. Gordon's splint is in extensive use. The present writer, like many other surgeons, prefers simple straight splints, of the width of the limb, and placed one on the palmar and one on the dorsal aspect of the limb. When adjustment has been secured, and while extension is still kept up, the palmar splint is fixed to the limb by wide pieces of strapping, three for the forearm and one for the metacarpal part of the hand. The splint reaches only to the heads of the metacarpal bones, so that from the first the fingers are left entirely free. The dorsal splint is then applied with wide pieces of plaster, and the two together are surrounded by a bandage. This method efficiently controls muscular action, and, as the dorsal splint can be removed without disturbing the palmar, the fracture can be easily inspected.

Before the splints—whatever form is chosen—are applied to this fracture, great care in modelling the fragments to a perfect adjustment must be used. The deformity which remains after repair is often due, not to recurrence of displacement, but to the fact that it had never been removed. In every case the fracture should be examined, to see that good position is main-

tained, twice or three times in the first fortnight. At the end of a month or five weeks in adults and the old, of three weeks in children, the splints may be discontinued. The forearm should, however, be kept in a sling for a week or ten days longer. In order to prevent stiffness, the fingers should be regularly exercised, and, as soon as the splints are left off, passive movement of the wrist and hand should be employed. The treatment ought not to be regarded as complete till motion has been, as far as possible, restored.

HOWARD MARSH.

RAILWAY INJURIES.—It is a common opinion that railway injuries present peculiar features of general nervous shock, and symptoms of spinal injury distinct from the sequelæ of ordinary accidents.

It is said that the greater severity of such symptoms is accounted for by the suddenness of the accident and the alarming character of the surroundings. It is open to question, however, whether the well-known symptoms that so commonly follow can always be accounted for in this way, for, as a matter of fact, injuries on the platform, and contusions in the street from collisions with railway vans, are nearly always followed by the same symptoms. Again, it is within the writer's knowledge, from experience in the treatment of a large body of men liable to injury from assaults, personal encounters, and street accidents, that symptoms precisely similar to those following railway accidents commonly occur.

As, in railway accidents, it happens that the most trivial injuries are followed by the most formidable array of nerve-symptoms, so it is with the men before mentioned, if injured on duty. The slightest cut or blow on the head, or a kick, is likely to be followed by loss of memory, defective sight, pain in the back, sleeplessness, and all the usual symptoms of nerve-shock. There is a condition common to both classes of injury, which must not be lost sight of by the practitioner. A person hurt on the railway knows that in nearly every case he is entitled to compensation, and the official, injured on duty, knows that he is entitled to a pension for life, if it is proved that he is incapacitated from the further performance of his duty thereby. On the other hand, the ordinary accidents of every-day life, such as falls downstairs, carriage accidents, and falls in the hunting-field, are not usually followed by such an array of nervous symptoms.

This assertion brings one face to face with very delicate questions—viz. how far

are those symptoms dependent on the injury, and how far are they dependent on the probability of obtaining pecuniary compensation for the injury? Then there is the further question. How far are the symptoms compatible with the reasonable anxiety and worry which are imposed by the prospect of litigation, and, on the other hand, how far are such symptoms purposely exaggerated or assumed? These are questions which must always exercise the mind of the practitioner who is called upon to attend such cases.

Railway injuries may be divided roughly into four classes, viz.: 1. Contusions and shocks, the result of slight collisions. 2. Fractures, dislocations, and concussions, caused by severe collisions and wrecks of trains. 3. Accidents on the line, including crushes by buffer accidents and limbs cut off by passing trains. 4. Platform accidents, caused by falls while getting in and out of trains.

Accidents belonging to the first class enormously preponderate, and as they are followed by every variety and degree of nervous shock, including the so-called railway spine, they demand the special attention of the surgeon.

Accidents of the second class present no special features distinguishing them from other injuries, and it is worthy of note that, after severe fractures and dislocations, the nervous symptoms are commonly less severe and less prolonged than after apparently trivial injuries.

Accidents of the third class generally occur to railway servants, and are often fatal. In shunting accidents, the abdominal or pelvic viscera are the seats of injury, and death may be occasioned by internal hæmorrhage, or by shock alone. In these cases, it often happens that the most extensive and severe internal lacerations may be present, without any external lesion or even a bruise. The injuries inflicted on limbs by carriage wheels are necessarily very severe, often resulting in immediate division of the part, or if not, so crushing the bones and soft parts as to require, in nearly every case, primary amputation. The distinctive character of these cases is that they are commonly fatal, in spite of the fact that the injured person is immediately carried to the nearest hospital, or surgical aid is obtained as quickly as possible. The usual explanation of the fatal issue is that it is caused by shock; but why a cleanly divided leg or forearm should cause fatal shock is at first sight difficult to understand. The explanation is that hæmorrhage in such cases is

very severe. The sharp edge of the wheels and of the rail act like scissors, and often divide a limb, or even the trunk, as if cut by a knife.

It is only quite recently that railway companies have seen the importance of providing immediate surgical aid, and the fatality of such accidents in the past has no doubt been due chiefly to hæmorrhage, and not, as was usually supposed, to shock. This fact is now so well recognised, that two of the largest railway companies in England have provided Esmarch elastic bandages, to be kept at every station, accompanied by printed directions for their use; and have also made arrangements for periodical instruction to be given to the officials and porters. (The instructions will be referred to under the head of *treatment*.) Again, ambulance classes are being held at most of the large railway termini, and it is to be hoped that a more general knowledge of how to give first aid to the injured will materially lessen the fatality of such accidents.

The fourth class, or platform accidents, may be sub-divided into two sections—1. Those caused by falling between the train and the platform, which are nearly always fatal, from the body being dragged down between the footboard of the carriage and the edge of the platform, thereby tearing off limbs, fracturing the pelvis, and causing terrible injuries. 2. Falls on the platforms, which are very common and entail much litigation. These injuries are seldom serious, but there is the disturbing element of litigation nearly always present, and there is generally a question as to the liability of the company. Moreover, it is a curious fact that some of the most aggravated cases of nervous disturbance and heavy claims for damages have arisen from trivial injuries of this class.

NERVOUS SHOCK.—This condition may be described as a functional disturbance of the sympathetic nervous system, directly affecting the vital functions, and also indirectly disturbing the functions governed by the cerebro-spinal nervous system. It is the peculiarity of railway accidents that nervous shock follows every conceivable variety of injury. It has hardly ever been the experience of the writer to see a crushed finger, a cut head, or a broken nose, or any other trivial accident occurring on a railway, which has not been followed by more or less nervous shock.

In considering the symptoms, it will be convenient to classify them as affecting

the different functions of the body and the organs of special sense.

Circulation.—The heart is primarily affected; the action is weakened and the beats are quickened and irregular. The pulse is rapid and weak in unison, and the surface of the body pallid and cold. The temperature often sinks one or two degrees below normal, and the body is bathed in a cold sweat. This condition may pass off in a few hours, or it may continue in a modified form for weeks or months.

Digestion.—The stomach is immediately affected by the nervous disturbance, as indicated by vomiting, foul tongue, indigestion and all its concomitant symptoms, loss of appetite, constipation, flatulence, and palpitation of the heart. Then follow loss of flesh, hepatic disturbance, mal-assimilation of food and gouty disorders, and even albumen in the urine may occur.

Sleeplessness.—This condition is always associated with nervous shock. Sleep, of course, is not totally absent, but it occurs in short snatches and is disturbed by dreams and visions, and there is no sense of refreshment or rest on awakening.

Sight.—This is usually impaired; dimness of vision and specks floating before the eyes are complained of. The pupils of the eyes appear abnormally dilated, and it not infrequently happens that the power of continuing the effort of reading is found to be notably diminished. This may be, and often is, the result of impairment of the function of accommodation by which the eyes are adjusted for near objects, or it may be a sort of inco-ordination arising from the nervous shock, and likely to pass away as the shock is recovered from. See VISION, Disorders of, from injuries of the head and spine.

Memory.—It is difficult to estimate how far the memory may be impaired. Patients usually complain that their memory is entirely gone, but at the same time they will relate, in minute detail, every incident connected with the accident, and give a long history of their symptoms. The truth is, the memory is not impaired, but the mind is alienated from the usual course of thought, and centred on the incidents of the accident. Thus, there is a difficulty in conversing on ordinary subjects, and a slowness in finding words to express the thoughts.

Moral Sense.—Nothing appears more demoralising than a railway accident. It is a common statement for a patient to make, that there has been no sleep for a month, or that not a morsel of food has been taken, and it is often painful to see the open at-

tempts at imposition. This happens constantly in persons who have been really injured, and is different from the deliberate and well-planned attempts to deceive which are characteristic of the malingerer.

Sensation and Motion.—These functions are frequently impaired. Anæsthesia is often found in men as well as in women, without any other symptom of hysteria. It frequently attacks the whole of one side of the body, and may occur with or without loss of motor power. The pulse on the affected side is small, the temperature is subnormal, and the skin pale. An arm, a leg, or even the course of a single nerve may be affected. Paralysis, again, is a very common result. It may take the form of paraplegia or hemiplegia, and is generally associated with anæsthesia. In these cases, the electric contractility of the muscles is usually unimpaired, but the sensibility of the muscles is more or less lost. Grave errors are of constant occurrence in the diagnosis of these affections, and after railway injuries there is a general tendency to attribute all such symptoms to spinal lesions, whereas, as a matter of fact, it is a very rare thing to find any spinal lesion following directly on railway injuries. The symptoms of hyperæsthesia and anæsthesia and paralysis, which so often follow such injuries, are in most cases purely functional, and correspond, in all their phenomena, to the symptoms which occur in ordinary hysteria. Other symptoms indicating some loss of the inhibitory power of the cerebrum are generally found—viz. the tremulous motion of the tongue and the shaking of the hands, as well as the tendency to cry when spoken to. Exaggeration of the reflexes is common, and sometimes even ankle-clonus is found.

Hearing.—Deafness is sometimes found, but it is not common. Persons often complain of noises in the head and inability to bear the slightest noise without starting.

Taste and smell are rarely affected, except in cases of hysteria.

Nervous shock may be the result of fright or of a very slight injury, and it is often a question whether it is not more the result of the events following than of the accident itself. Often, the sequence of events after a railway accident is as follows. The frightened or injured person is immediately dosed with brandy. He is naturally nervous and excited, and on arriving at his destination the doctor is sent for, who does not always reassure his patient. Then follows a sleepless night, with dreams and visions, and thoughts of

paralysis and spinal injury. Rest, narcotics, and stimulants are prescribed, with the usual results of dyspepsia and headaches. The patient becomes really ill and nervous, as well as apprehensive. At this period, a plucky resolve to throw physic away and stick to work would soon re-establish the usual health, but unfortunately there is, generally, passive resignation, and no effort of any sort is made to resume work. Should there be an attempt it is not persevered in, and the patient, without actively intending to impose upon himself and others, will soon work himself up into a state of nervous apprehension, which rapidly develops all the symptoms of severe nervous shock. It must also be remembered that a person may actively encourage emotional disturbance, by which a similar result may be produced. This condition may be justly said to be a borderland which approaches malingering as nearly as can be.

On the other hand, no doubt many cases occur where a severe shake or concussion does produce general nervous shock, the effects of which it is very difficult to shake off, and which renders the patient absolutely unable to follow his usual avocations. Again, severe shock may accompany traumatic lesions of the limbs or organic injuries to the viscera or nerve-centres; but, in the majority of cases where nervous shock follows a railway accident, it is a moral disease and is not directly due to any physical injury.

In ordinary cases, shock to the nervous system is completely recovered from after a variable period, but elderly persons are sometimes permanently affected. The early symptoms may not be severe; in fact, the emotional condition may be absent, and there may be no special symptom beyond a general sore feeling in the back or legs. Soon the usual cheerfulness is lost, the gait becomes feeble, the circulation weak, and the person gets thin and pallid. There may be no headache, nor loss of sleep, nor any particular pain, yet complaint is made of feeling ten years older, and friends and acquaintances corroborate the statement, judging from appearances. In such cases, there is nothing of the nature of spinal disease to be apprehended in the future; but it may be taken as a general rule that the person will never be as well as before the accident.

CONCUSSION OF THE SPINE.—This is a term difficult to define, for, as the phrase is usually employed, it includes several distinct conditions:—1. A jar or shake to the spinal cord, causing pain and disturbed innervation without any symptom of special lesion.

2. A condition depending on pressure, either of extravasated blood or by exudation of serum. 3. Alterations in the structure of the cord itself, the result of chronic inflammatory changes either in the substance or in the coverings of the cord. The term 'railway spine' is often applied indiscriminately to any of these conditions. These may be the result either of direct or indirect violence. The primary symptoms will, of course, vary according to the severity and position of the injury. In the upper cervical region, grave danger may occur to life from implication of the large nerve-trunks, which take their origin from the medulla oblongata. If the vagus nerve be affected, the symptoms of dyspnoea will be urgent; if the phrenic, a feeling of constriction of the chest, caused by paralysis of the diaphragm will be felt. A blow on the lower part of the cervical spine has been known to induce paralysis of both arms, without any paralysis of the trunk or legs; sometimes there is loss of sensation, in other cases there is hyperæsthesia, but in this respect there is every variety and combination of nerve-disturbance.

A blow on the dorsal or lumbar region may cause complete loss of voluntary power in the lower limbs, with or without loss of sensation. One leg is usually more affected than the other. The patellar reflex also is generally much increased. There is often complete loss of power over the bladder, accompanied by incontinence; less frequently there will be retention. The usual symptoms of nervous shock will be present, the most prominent being pain in the head, furred tongue, constipation, pain in the back, and intense neuralgic pain in the affected limbs. A pricking sensation is also often complained of, and there is great skin sensibility over the lumbar and sacral regions. There is pain on pressure—generally referred to the lumbar region in the middle line, and radiating to the sides. There is difficulty in turning over in bed. If walking be possible it appears difficult; the legs are spread open as if to make a wider base for support, and the position of the body is fixed and constrained; there is no power to stoop to pick up anything; the appearance is as if the sacro-iliac joint were injured.

A marked peculiarity in cases of concussion is the frequent coincidence of nervous disturbance, affecting the part supplied by the spinal nerves which emerge opposite to the part struck. On the hypothesis of concussion of the substance of the cord this is difficult to understand. One would expect the nervous disturb-

ance to be wider in its radius; and when it is considered how thoroughly the spinal cord is protected from external injury, both by its solid case and elastic surroundings, also how completely it is protected from jar through being suspended in a double tube—viz. the spinal canal on the outside, and the fibrous sheath (with an interspace of fluid) on the inside,—it seems reasonable to suppose that the nerves which emerge from the injured spot are alone affected. The cord being somewhat movable, it is easy to understand how a sudden blow may cause a stretching or strain of the nerves as they pass through the intervertebral foramina, or the nerves may be pressed upon by an effusion of serum or blood outside the sheath of the cord. No doubt this often happens; and, even when symptoms of injury to the cord may co-exist, it is more than probable that they may be caused by irritation reflected from the injured nerves.

For a description of injuries to the muscles and ligaments of the back, see BACK AND SPINE, Injuries of the.

REMOTE INJURIES.—It is a commonly stated opinion that railway shock is peculiarly liable to be followed by organic disease of the spinal cord. The experience of the writer, however, does not support this view, for during the last six years, out of more than 500 cases examined, where claims have been made for personal injury, in half-a-dozen cases only were undoubted symptoms of organic disease found. Two of these were cases of tabes dorsalis, and a third a case of cerebral hemiplegia. In another, paralysis from disease of the spinal cord was present, but in this case the symptoms had commenced before the accident. No doubt, after spinal concussion, slow inflammatory changes occasionally occur in the cord or in its membranes, and may result in degeneration of nerve-tissue. Two forms of degeneration have been described: the one chronic meningitis with myelitis, the characteristic signs of which are a localised pain in the spine, greatly increased by movement, rigidity of the body or of the limbs, with spasmodic contraction of muscles and great muscular rigidity. The patient resents the slightest displacement of the body. These symptoms are generally accompanied, more or less, by cerebral symptoms—viz. headache, loss of memory, intolerance of light, suffusion of the eyes, noises in the head, &c. There is no paralysis of the sphincters, but often some loss of motor power affecting one or more of the limbs. There is exaggeration

of reflexes, also skin hyperæsthesia extending along the course of the nerves, and sensations of pins and needles in the limbs. There is a peculiar, unsteady, rolling gait; the legs are placed far apart, the heels drag, and the body is kept rigid either in the erect or bent posture. The other form of degeneration is sclerosis. This condition may no doubt follow traumatic injuries of the cord, but is more likely to be the result of mental shock or prolonged hysteria. There are no definite symptoms except a gradually increasing paresis of the lower limbs, extending ultimately to the upper limbs. There is no loss of ordinary sensibility; the muscles shake and quiver when called into action, ankle-clonus is distinct, and the reflexes are often exaggerated; there is no wasting of the muscles, nor any loss of electrical excitability.

Tabs dorsalis may, possibly, be a rare result of railway injury. In these cases sclerosis of the posterior columns is found, but it is more probably the result of indirect causes than of actual injury to the cord. Of the two cases which occurred in the writer's experience, in one there was a history of symptoms before the accident, and in the other the man was of an intensely neurotic temperament, and, besides the railway shock, had recently been subject to domestic bereavement, and had great business worry. There is another condition described which is known as 'spinal anæmia,' but it is questionable whether this is a pathological condition. It is generally accompanied by hysteria. The symptoms are as follows:—There is intense hyperæsthesia, greatly increased by pressure and by the application of a hot sponge; the tenderness is usually diffused more or less over the back: it has no tendency to follow the course of the nerves. In the more severe cases, there is often loss of motion in the lower extremities: the legs and feet are cold, and the reflexes are absent. In this case, again, it will be found that the sphincters are not paralysed, and that the general health is often good.

Hysteria is a common sequence of nerve-shock, especially with women. The patient becomes emotional; she bursts into tears, or is quick-tempered and violent; she dwells on her symptoms, exaggerates all her injuries, is untruthful, and her moral nature appears perverted. She may simulate disease consciously or unconsciously, and practise all sorts of tricks in order to deceive the persons around her. Hysterical paralysis is very common after railway injuries. It usually takes the form of para-

plegia. Tonic spasm of the limbs is also frequent. Hyperæsthesia, anæsthesia, convulsions, and mania are all common in these cases of hysteria.

METHOD OF EXAMINATION.—A practitioner, who is called on to report on a railway accident, cannot be too careful in keeping an accurate record of the case. The notes should be taken as follows:—State the date and place of examination; name, sex, age, occupation; married or unmarried; in the case of women, number of children; date and place of accident, and also the patient's description of the accident and events immediately following; when seen by a doctor, and by whom; patient's history of symptoms to date; patient's description of present condition. In examining the patient, avoid putting leading questions as far as possible. Make a note of each organ examined, and describe any local injuries found.

Where injury to the spine is supposed to exist, examine by percussion; examine surface sensibility by hot sponge, by touch with the finger, or with a feather.

Where paralysis is alleged, measure the limbs most carefully and compare them with each other; note the strength of the muscles by the grasp of the hand or power of locomotion; examine the patellar reflex, and also the power of contraction of the muscles generally, and whether ankle-clonus is present. The electrical irritability of the muscles may be tested, but there is a great deal of confusion existing regarding the utility of the electrical phenomena. This is due, not so much to the difficulty of interpreting facts, as to the general absence of technical knowledge necessary to elicit them with accuracy and precision.

The eyes should always be examined, and the condition of the pupils noted. An ophthalmoscopic examination is also desirable, and in some cases essential, as the existence of lesions of the retina may be confirmatory of cerebral or spinal symptoms.

The urine should always be examined for albumen and sugar, and the specific gravity should be taken, as well as the reaction with litmus paper. If possible, the medical history of the case should be taken down as related by the patient's medical attendant, and the treatment, past and present, noted. It is also desirable that a consultation should be held apart from the patient, in which the medical men in attendance on the patient should be invited to take part. This procedure is not always followed, and sometimes may not

be considered necessary or expedient. The diagnosis of the injury should be agreed upon as far as possible, and a note should be made whether opinions coincide as to the diagnosis and prognosis; especial note should be made of the period that will be probably required for partial or complete recovery. The amount of compensation should not be discussed; it is, however, quite within the province of the medical men to agree upon a time, during which the patient is likely to be incapacitated, as a basis whereon the railway company may estimate the amount of compensation that should be awarded.

All original notes of the examination should be carefully preserved, and they should be made at the time of, or soon after, the examination.

COMPENSATION.—Occasionally, both the claimant and the railway company agree to have the amount fixed by the medical men. It is not a task that should be lightly undertaken by them, and it should never be considered a part of their duty. In dealing with this subject there are three points to be considered:—1. How long has the claimant been incapacitated from business? What has been his loss thereby, and how much expense has he legitimately incurred? 2. How long is he likely to be incapacitated and what loss and expense is he likely to incur in the future as the direct consequence of his injuries? 3. What is a fair sum to fix as a solatium? In other words, how much should be paid for the pain and suffering he has had to endure?

Considerable diversity of opinion may naturally be expected on this latter point, and, at first sight, it would seem only fair that the position in life of the claimant should make no difference in assessing the solatium. Thus, if a labouring man with a broken leg should be paid £100 for his pain and suffering, a professional man earning £1,000 a year should only be entitled to a similar amount. Juries, however, do not usually take this view, and the heavier the pecuniary loss, so much the more do they give as solatium. After all, this is not unreasonable, for £100 to a labouring man would appear a good sum, whereas to the professional man it would be a very poor recompense for the suffering he had undergone. It is the practice to take into consideration the comparative value of money to the injured persons. This, however, should be done only within narrow limits. It would be impracticable as applied to a peer with £50,000 a year,

and would be most unjust to the railway companies, though no doubt £5,000 would not appear of greater money value to him than £500 to the professional man, or £100 to the workman.

Arrangements as to compensation, made between the company's medical man and a plaintiff, are scarcely ever proper, and never prudent. To say nothing of the fact that the bargain for terms of settlement is not the business of a medical man, the parties are not upon equal terms, their means of knowledge are essentially different. The more delicately and kindly the medical man has discharged his duty in watching the case on behalf of the company, the more will a kind of confidence on the part of a sufferer have sprung up, which tends to place him at an additional disadvantage. So strong is the feeling against such arrangements, that they can rarely be maintained. There is no legal difficulty in their way; the doctor is not the doctor of the patient, and there is no such 'confidential relation' as renders them theoretically incapable of enforcement. But they are open to so much of well-grounded suspicion that juries will rarely believe they are honest, and judges are prone to take the same view, so that they have a very slender chance of success; whilst the mere fact of having attempted to make them is felt to be discreditable, and to lower the position and reputation of the medical man to whom it is brought home. As before mentioned, cases may sometimes occur, in which the medical man employed by the company and the medical man employed by the plaintiff may fairly and properly come to arrangements for settlement of claims for personal injury. But, even here, there is frequently room for suspicion and unfavourable comment. When, as has sometimes happened, it has been part of such an arrangement that the company should pay the bill of the medical man who has acted for the patient, the bargain, however honest, is likely to be treated by juries as fraudulent, if afterwards assailed by the patient, and no prudent or experienced practitioner ought to place himself in a position from which he can scarcely escape without discredit.

PRIVILEGED COMMUNICATIONS.—Communications between solicitor and client are privileged from discovery, so also are all documents prepared for the *bonâ-fide* purpose of being laid before the solicitor of the patient in order that he may advise his client thereupon, whether prepared at his instance or not. Reports therefore made

really, and not merely colourably, for the purpose of being laid before the solicitor of a company to assist him in giving his advice to the company or its directors or officers, are privileged from production to a plaintiff. Not so, however, if prepared for the use primarily of the directors, so that, as a general rule, reports or letters addressed to the directors, secretary, manager, or other officer of a company may be inspected under a judge's order.

Notes of verbal reports fall under the same rule. If intended for the use of the solicitor to enable him to advise his clients, they are protected. If for the use of some officer of the company or the directors, they are liable to inspection.

PROFESSIONAL ETHICS.—In arranging examinations and consultations, there are many points to be observed. A medical man, acting on behalf of a railway company, has no right to examine an injured person except with the consent of the patient, his doctor, or his solicitor. If such consent be not given, and if an action is pending, there is no power of compelling a medical examination of a plaintiff except in the manner provided for by 31 & 32 Vict. c. 119, sec. 26, which is, that the judge may order an examination, for the benefit of the tribunal, by a medical man named by him who is not a witness. This is rarely acted upon, consequently, an examination being a matter of arrangement merely, the plaintiff can impose any conditions he chooses, and the other side must submit; thus, the solicitor for the plaintiff may insist on being present. In such case, of course, the solicitor for the other side has a right to be present also.

In consultations between the medical officer of the railway and the plaintiff's doctor, the former usually fixes the appointment, for the reason that he often has a long distance to travel, and is generally a consultant; but, of course, the plaintiff and his doctor and solicitor have a right to fix the time and place for the examination. If several consultants be engaged, it is usual for the consulting officer of the company and the ordinary medical attendant of the patient to arrange the appointments. Sometimes the fixing is left to the solicitors, but it is not a good plan, as they do not know how best to study the convenience of the consultants.

A railway surgeon should never consent to examine a plaintiff in the presence of his solicitor alone. If the plaintiff's doctor cannot be present, then the railway company's solicitor should attend as well,

but it is never desirable that solicitors should be present at a purely medical or surgical examination. Again, a railway surgeon should never visit a plaintiff alone, if it can be avoided. In the case of *Casson v. Great Western Railway Company*, tried at Birmingham, the plaintiff swore to a conversation between himself and the doctor, not a word of which had ever taken place. Luckily, an inspector was present, who was able to prove that the conversation, which was narrated, had taken place between himself and the plaintiff on a previous visit. Leading questions should not be put, nor is it wise to make any remarks bearing on the case, in the presence of the plaintiff. It is no part of the duty of a railway surgeon to interfere with the treatment, though, as a matter of fact, suggestions are often asked for and adopted by the plaintiff's doctor. Sometimes, an injury is discovered by the railway surgeon which had not previously been diagnosed. Opinions may vary as to his duty in such a case. The writer has no hesitation in saying that it would be incompatible with a high standard of duty and professional honesty to conceal such a discovery. Although he is surrounded by pitfalls on every side, and sees tricks and deceit constantly practised, absolute professional honesty and candour should be his guide in every case. It must be remembered that medical men attending cases of railway injury have no right to increase their fees. The scale should be such as would be charged to persons in the same rank of life, suffering from ordinary illness. With regard to attendance in court and journeys on behalf of railway companies, special arrangements should be made beforehand.

MEDICAL EVIDENCE.—With regard to medical evidence in cases of railway injury, there is much that is unsatisfactory. There are, unfortunately, medical men who encourage fraudulent claims, by acting in concert with speculative solicitors. In case of the claim being lost they agree to waive payment, but, if compensation is obtained, they get a good share of the plunder. Again, some men ignorantly encourage fraud by recklessly asserting that every slight case of injury is likely to be followed by disease of the spinal cord. It is also very common for medical men to allow their sympathy for an injured person to influence their judgment, beyond all bounds of fairness and common sense. On the other hand, it is alleged that railway surgeons commonly ignore all injuries, and it is a usual custom in courts of law to attempt

to discredit their honesty. Whether this imputation be deserved or not, it has led to a most unfortunate custom—that the very suggestion of possible fraud, even in the most flagrant case, is sure to bring down on the surgeon a vigorous attack from the plaintiff's counsel, and a cross-examination intended to suggest want of honesty and indifference to anything except the interest of the railway company. The eloquence on this point is usually so effective with the jury, that the counsel for the defence is unwilling to allow any imputation of fraud to be made, even if there is clear evidence of it.

It must be conceded that it is the duty of the railway surgeon to keep an unbiassed mind. He sees so many cases of attempted and successful fraud, that there certainly is a risk of his mind being soured and his judgment perverted. In every case, he should be able to give his reasons for statements and opinions, and he must take care not to allow any amount of exaggeration or fraud to turn his mind from the recognition of injuries that do exist. There should be no suppression of opinion that might be unfavourable to the company. It has sometimes happened that opinions expressed by the medical witnesses for the plaintiff have appeared to the counsel for the defence less prejudicial to his case than the opinions held by his own professional witnesses, and in defending the action he has wished to adopt the theory of the other side; but the zeal of the advocate should never extend to the medical witness. It would be a gross impropriety for him to suppress or modify his opinions at command of counsel; the only alternative, for a counsel who wishes to adopt the opinions of the other side, should be not to call his medical witnesses.

The witness should remember that technical terms are to be avoided as far as possible, and that his opinions should be expressed in such language as to be intelligible to the judge and jury.

Again, the medical witness should know that all original reports and notes are liable to be called for, and, if so, must be produced. The witness should never lose his temper, and all questions should be answered respectfully and to the point. Where it is impossible to answer a question without an explanation, it is better to appeal to the judge for permission to make it. Counsel are very apt to insist on 'yes' or 'no' for an answer in cross-examination, but, of course, are bound to allow an explanation if the judge permit it.

Diagnosis.—The difficulties of diagnosis in railway injuries are well known, and are being continually illustrated in the law courts. This is not to be wondered at, as we may have, mixed up in one subject, the symptoms of fright, nervous shock, injuries to muscles and ligaments, hysteria, spinal and brain concussion, organic injury to brain or spine, and, added to these, symptoms either imagined or invented. The first point, of course, in diagnosis, is to differentiate symptoms of real disease or injury from those imagined or invented. That malingering is common cannot be denied, but the medical man is never justified in concluding that symptoms are assumed (however inconsequential they may appear), until he has satisfied himself by the most careful tests that they cannot be produced by nervousness or hysteria. The variety of cases in which such tests require to be applied, precludes the possibility of giving any general rule for testing the genuineness of symptoms. The surgeon must rely on his own judgment and sagacity in each individual case. Mr. Erichsen writes: 'When symptoms are invented or wilfully exaggerated in order to mislead, the fraud may usually be detected, by a surgeon accustomed to these investigations, by finding that the symptoms do not bear a due proportion to one another, that one is brought into greater prominence than the rest, and that the patient contrives to direct attention to and lay emphatic stress on it. There is, in fact, an absence of that harmony of symptoms which characterises all true and real diseases.'

Notwithstanding the extreme difficulty in diagnosing the effects of railway accidents, opinions are given and sworn to in these cases, with a recklessness which would be deemed most culpable in ordinary illness. One reason is that the directors of the railway companies require from their surgeons a definite opinion on the case at an early period—first, as to the nature and extent of the injury, and whether it is likely to be permanent; secondly, how long the effects will last or incapacitate the person from his usual employment. These opinions have to be formed, generally, after a single visit. On the other hand, the practitioner in attendance is equally pressed by the injured man's friends or solicitor for his opinion, in order to make a statement of claim for compensation; and thus it is that, on the one side, insufficient opportunity for observation, and, on the other side, inexperience or undue bias in the interpretation of the symptoms which so commonly follow

railway accidents, lead to such divergences of opinion, and such pitiable exhibitions in the witness-box, as to be a byword of reproach to the medical profession. In injuries where there are objective symptoms, the same rules of diagnosis will apply as to ordinary accidents; but often, when the railway surgeon examines a case, all objective symptoms will have disappeared, and yet allegations may be made of grave injury remaining.

It cannot be doubted that the diagnosis between malingering and hysteria is most difficult. It has happened, again and again, that symptoms which have been pronounced hysterical by the most competent physicians have disappeared directly after the trial; and in one case lately tried, where large compensation was obtained, and where the doctors on both sides agreed that the case was one of aggravated hysteria, the woman took a public-house directly after the accident, and boasted to her customers how she had 'done' the doctors.

After falls on the platform, a claim is often made for permanent injury to the hip-joint. No doubt, a fall on the hip may either bruise the joint, or may cause some inflammatory exudation around the sciatic nerve. Lameness and pain are complained of, and large claims for compensation are made. The difficulties in the diagnosis are as follows:—First, whether the patient is really suffering; secondly, whether, if suffering be present, it is due to the injury or to ordinary sciatica or rheumatism of the joint.

Ruptures are often discovered after railway accidents, and no doubt a sudden jerk may produce a hernia; but if coming down for the first time through violence, great pain would immediately be felt, whereas, in the great majority of the cases complained of, it will be found that the rupture was discovered only some weeks or months after the accident, and usually after a claim for compensation had been made. It is a very common method of making a fraudulent claim. In some cases, no doubt, fraud is not intended. The plaintiff is thoroughly overhauled for the purpose of making a statement of claim, and the rupture is discovered for the first time. It is necessary in such cases to make close inquiry into the history of the swelling, whether a truss has ever been worn, and whether the patient has been ever examined for a club or for life assurance. It is sometimes impossible to say how long a hernia has existed. The abdominal rings may have been weak and

bulging for years, and the slightest exertion may bring on the hernia, without causing pain or inflammation; but a hernia, coming down through a strong abdominal ring on account of violence, would be accompanied by sudden pain, and probably sickness and shock.

It is possible that a hydrocele may be caused by a blow on the testicle. In a recent case, such an injury was alleged to have been caused by a railway accident. A month after the accident one testicle was enlarged, and very hard and irregular. There was a good deal of fluid in the tunica vaginalis, but the tissues were much thickened by chronic induration, and not thin and distended as in a recent case of inflammatory exudation. Again, the surgeon who examined the plaintiff directly after the accident found the testicle in exactly the same condition as at the later examination. This was reported as a fraudulent claim, and compensation was refused.

Where injury to the nervous centres is suspected, the following points in diagnosis must be made out:—1. Whether the symptoms are real. 2. Whether the symptoms are due to a general shock to the nervous system. 3. Whether to concussion of the brain or spinal cord. 4. Whether to organic injury or disease affecting the brain or spinal cord or nerve-trunks. 5. Whether to injury to the muscles or ligamentous tissues of the back. 6. Whether to rheumatism. 7. Whether to hysteria.

Now, considering that the symptoms may be purely subjective, and that nearly all the above conditions may co-exist, it will be understood how difficult the question of diagnosis must be in certain cases. The history of each particular case must be minutely investigated, and a careful comparison of the subjective with the objective symptoms must be made. Again, where malingering is suspected, the relative compatibility of the symptoms must be examined. It must also be remembered that there are different degrees of malingering:—1. There may be the actual assumption of symptoms which have no existence. 2. The reference of old diseases or symptoms to a recent accident. 3. The wilful exaggeration of injuries which really exist.

In general shock to the system, the diagnostic symptoms are mostly subjective—viz. sleeplessness, headache, loss of memory, defective eyesight, constipation, pain in back; the objective symptoms being disturbance of the circulation, weak or intermittent pulse, foul tongue, and exaggeration of the reflexes.

When there has been concussion of the spinal cord, there is pain in the back, generally most severe in the lumbar region; pain on pressure over the spines of the vertebrae, varying in extent; hyperæsthesia of skin; irritability of the bladder; diarrhoea or constipation; great pain in turning over in bed, or, if able to get up, inability to stand upright or straighten the back; a stiff and constrained position in walking, with the legs spread open as if unable to balance the body; radiating pains of a neuralgic character down the legs, and feelings of pins and needles.

In brain-concussion there is the history of a blow on the head, loss of consciousness at time of accident, subsequent pain in head and confusion of ideas, suffusion of eyes, intolerance of light, feeble pulse, accompanied more or less by symptoms of general shock.

Where paralysis is present it may be functional (including hysterical paralysis), or it may depend on organic injury to the brain or spinal cord or peripheral nerves. In functional paralysis the muscles retain their nutrition, or, if there be wasting, this is of the character of general emaciation from simple disuse, and is not an atrophy of particular groups of muscles. As a general rule the electrical reactions are normal, but after very long disuse there may be sometimes, at first, a slight loss of irritability to induced currents. After a very few applications, however, this passes off. It is to be noticed that the lowered irritability obtains equally as regards not only the induced, but the galvanic, current also.

In paralysis from lesions of the brain, there is ordinarily nothing abnormal to be noted in the electrical reactions of the muscles of the affected limb, and this applies also to a lesion limited to the lateral or posterior columns of the spinal cord. But, if the anterior horns of grey matter in the cord be affected, there are—1. Loss of power in certain muscles of the limb supplied by nerves issuing from the affected part of the anterior horns. 2. The tendon reflex in the affected muscles is absent. 3. The paralysed muscles tend to atrophy. 4. Examined electrically, it is found that the reaction to induced currents is materially lessened or entirely absent, and this whether the rheophore be applied either to the muscles or the nerves supplying them. If, however, the rheophore conveying a galvanic (constant) current be applied to the muscle, and the current slowly made and broken, there will be contraction—

strongest when the positive pole is applied. If the galvanic current be applied to the nerve only, there is no reaction.

Similar phenomena result when, instead of disease in the anterior horn of grey matter, the lesion is situated in the trunk of a motor nerve. They are absolutely indicative of organic lesion of a certain part of the spinal cord or of the trunk of a nerve. A destructive lesion of the spinal cord, high up (say in mid-dorsal region), will cause complete paralysis of the lower extremities and viscera, and yet the electrical reaction of the paralysed limbs will be normal, because the anterior horns of grey matter, at the point of origin of the motor roots of nerves going to the limbs, are unaffected. The paralysis here depends not upon lesion of the anterior horn of grey matter, or of the trunk of nerve, but upon the interruption to the descent of voluntary impulses from the intracranial centres along the antero-lateral columns of the cord. The tendon reflexes in this condition are exaggerated. They are also in excess as a result of secondary degeneration from disease of the motor area of the cerebral cortex. They are usually also heightened in functional paralysis. It may be said, generally, that the conditions of the muscles in functional paralysis, as regards electrical reaction, nutrition, and tendon reflex, resemble those of limbs paralysed as a result of cerebral and not spinal lesion. The diagnosis between functional paralysis and paralysis from an intracranial lesion requires the consideration of a large number of possibly attendant circumstances, the discussion of which is impracticable in an article of this scope. Reference must be made to special works upon disease of the nervous system.

The use of electricity, as a diagnostic agent in investigating injuries after railway accident, may be summed up shortly as follows. If, in a given case of asserted paralysis, the electrical reactions are found to be universally normal, it may be concluded that the injury is not due to any organic disease of the muscles, the nerves, or the anterior cornua of the cord. It does not, however, exclude lesions of other portions of the cord, such as lateral sclerosis, locomotor ataxy, affections of the brain, such as cerebral hemiplegia, or functional disorders such as hysteria. In these the electrical reactions are practically normal, and the diagnosis must be determined by other concomitant symptoms. If, on the other hand, positive evidence of abnormal electrical reactions can be obtained, it is a

certain proof of organic tissue-change in either nerve or muscle. These abnormal changes may be in nerve alone, in muscle alone, or in both together. They may be distributed in a variety of ways, a knowledge of which, combined with the other circumstances of the case, generally enables the inquirer to diagnose the seat of lesion—that is, whether it originates in the nerve, the muscle, or the cord.

As a matter of fact, organic disease of the nervous centres is of very rare occurrence after simple collision, and even after direct traumatic injury to the spine it is not common.

Where injury to sight is alleged, it will of course be a question for diagnosis whether the eye has been directly injured. Such cases would not be likely to differ from wounds or contusions arising in any other manner, but claims for remote or indirect injury are frequently made, and no doubt are, in a certain proportion of cases, well founded. A person, who is confined to bed or to a sofa by the effects of a railway collision, would often be desirous to while away the tedium of such confinement by reading, and it is often found that the power of continuing the reading effort is diminished. So long as the distant vision remains of normal acuteness, or can be brought up to normal acuteness by a lens, the mere failure of reading power need occasion little or no anxiety. It is a symptom of nervous shock which will disappear with restoration of the general health, or which, at most, will require an earlier employment of spectacles than might otherwise have been necessary. Sometimes, however, the acuteness of distant vision suffers, and then, even if the diminution should at first be but trifling, the case assumes a serious aspect. Injuries to the nervous centres may affect the optic nerve and retina in two ways: by the production of neuritis, probably leading to eventual atrophy and blindness, or by an atrophy without antecedent neuritis, a so-called 'simple' or 'sclerosal' atrophy, which, although producing great impairment of sight, sometimes stops short of complete blindness, and which may probably be attributed to injury of the nerve-centres which govern the nutrition of the optic nerve.

In every case in which impairment of vision, as distinguished from diminution of endurance, is complained of, the eye should be subjected to early and complete examination with the ophthalmoscope, by which, in the earlier stages of neuritis, some

blurring of the disc and some vascularity of the nerve-tissue will be detected; while, in the instances of simple atrophy, the nature of the change must before long be apparent. At the same time, the actual state of the visual function, as regards acuteness, extent of field, colour sense, and accommodation, should be investigated as carefully as circumstances will permit, and with reference not only to prognosis but also to treatment. The surgeon will frequently have to deal with cases in which the truth is more or less obscured by nervous excitement or by actual simulation; but these conditions before long cease to be deceptive. It is necessary to be provided with a sufficient variety of lenses, test-objects, and methods of examination; and any attempt at malingering would certainly soon be exposed by the contradictions and inconsistencies to which it would lead. But it must be remembered that a superficial knowledge of diseases of the eye is insufficient in dealing with such cases; the aid of an experienced oculist should be obtained before forming a definite opinion. *See VISION, Disorders of, from injuries of the head and spine.*

Treatment.—In severe injuries prompt treatment on the spot is of the first importance; arrest of hæmorrhage, relief of shock, and easy transport should be the surgeon's first consideration. The following printed directions have been issued by the London and North-Western and Great Western Railway Companies, and are in use at all stations for the instruction of the officials, accompanied by an Esmarch's elastic tube:—

Rule 1.—When a leg or arm is severely wounded there may be no bleeding. In this case raise the limb on cushions above the level of the body, and carefully watch the wounded part, so that the first bleeding may be seen.

Rule 2.—Should there be much bleeding, put on the elastic tube as soon as possible (see *Rule 3*); but if you have not got the tube near, raise the limb as high as you can above the body, and act as follows:—(a) If blood seems to come smartly from one part, place your finger and thumb firmly on that part, and stop up the place from which the blood is coming. (b) If you cannot see whence the blood flows, then roll up your handkerchief or cap, and with it press firmly over the bleeding part, not forgetting to keep the limb raised up.

Rule 3.—To put on the elastic tube, let the limb be held up as high as possible, then stretch the tube to the full, and wind it while stretched round and round the bare limb. When this is done, fasten the hooks at the ends to each other.

Rule 4.—The tube must be placed above the wounded part—that is, between it and the body. (a) When the leg or foot is injured apply the tube just above the knee; if the knee or thigh be wounded, then place it higher up on the thigh. (b) If the hand or wrist be wounded, put on the tube below the elbow; if blood come from the elbow or arm, then put on the tube higher up near the shoulder.

Rule 5.—If the limb be wounded so near the trunk that you cannot put on the tube, then you must do your

best to stop the bleeding by one of the plans named in Rule 2.

Rule 6.—If the injured person has to be carried far, either to a hospital or to a house, bear in mind—(a) To keep him warm with rugs or clothing. (b) To keep the limb continually raised on cushions. (c) To watch for bleeding. (d) Not to give too much brandy, especially if you have not been able to put on the tube.

Fractures may be treated by temporary splints made out of newspapers, the cushions of railway carriage-seats cut up; and straps and handkerchiefs or shirt-tails will make good bandages.

For the immediate relief of shock, avoid transportation to long distances: utilise cottages or buildings near the scene of the accident; insist on rest and quiet, and freedom from exciting interviews with friends; give diffusible stimulants or alcohol in moderation; also give hot coffee and beef-tea, when possible. For the treatment of nervous excitement after shock, bromide of potassium, in ten-grain doses, combined with the same quantity of carbonate of ammonia, may be given in an effervescent form with good effect.

Opium, chlorodyne, hydrate of chloral, &c., are usually contra-indicated, as they generally increase the nervous excitement. They should be given only in cases of severe organic injury, to relieve pain. With regard to operative measures, fractures and dislocations should be reduced at once, and, in injuries which require amputation, a primary operation is generally best. There is usually little chance of saving limbs, with comminuted and compound fractures especially, where joints are involved; and there is much risk to life in the attempt to do so. Of course, it is often necessary to wait for the first effects of shock to pass off.

The treatment of fright and emotional and functional illness is often a question of difficulty. It may be taken, as a general rule, that the less medicine given the better, and that as little fuss be made and as little anxiety shown as possible. But the surgeon is often in a dilemma. Many patients resent most vigorously any light estimation of their injuries, and any encouragement to resume work or get about is looked on as inattention or ignorance. Then, again, the friends usually interfere, and another and a more sympathetic doctor, so called, is recommended. It follows, therefore, that moral treatment is necessary. The confidence of the patient must be first gained by sympathy and attention, then he may be informed of the nature of the symptoms, and will more readily follow the necessary treatment.

The symptoms which most commonly require active treatment are dyspepsia, con-

stipation, and sleeplessness. For dyspepsia, a dinner pill containing a grain each of gray powder, euonymin, and powdered rhubarb may be given before each meal, and an effervescing saline with ammonia, after meals, is very efficacious for pain and flatulence. For constipation, by far the safest and most effectual drug is cascara sagrada. It does not debilitate nor depress the nervous system like saline aperients and mineral waters, nor is it followed by constipation, like most of the cathartics and other aperients. A very good formula is the following:—Liquid extract of cascara, f3j.; syrup, f3j.; maltine, f3ij. One or two teaspoonfuls to be taken before the evening meal or at bedtime, in water. For sleeplessness, it is a very bad plan to give large doses of bromide, and as for opium, morphia, chlorodyne, and hydrate of chloral, there is no surer way of retarding recovery than to give them. As the general symptoms of shock subside, sleep will return, and good nights may often be obtained by a glass of hot whiskey and water at bedtime or hot beef-tea or gruel. Many of the symptoms of nervous shock are much aggravated by the injudicious use of strychnine and iron. It is not unusual to find that large doses have been given from the date of the accident, generally with the effect of producing palpitation, twitching of limbs, sleeplessness, sensations of pins and needles, headache, and dimness of sight, all of which symptoms are immediately attributed to the accident, and any nervous shock that may have been sustained is thereby materially increased.

In cases of persistent nervous shock, leading to hypochondriasis, hysteria, and other neurotic symptoms, such as paralysis, hyperæsthesia, or anæsthesia, change of air and scene is a good remedy; but when this is recommended, the beneficial effect that would ensue is often retarded by the anxiety and officiousness of friends or relatives who accompany the patient, and never cease to talk of the accident or to enlarge upon his injuries. Again, it is common to find the nature of the symptoms misunderstood, and often escharotic liniments, blisters, and even the actual cautery, are applied.

There can be no doubt that, in such cases, treatment at a hydropathic establishment is most advantageous. Isolation from friends, change of scene and habit, absolute regularity in diet, freedom from stimulants and narcotics, are thus ensured, while there is every convenience for sedative local treatment by shampooing, massage, douching, and compress; and, lastly and most import-

ant, the attention of a medical man understanding the moral treatment of the patient is secured. There is a certain proportion of cases, however, where nothing but money compensation will do any good. Those persons are not always dishonest—the worry of impending litigation, or anxiety about business losses, may keep up the nervous state; others, knowing that pecuniary compensation is certain to be obtained, will not make the slightest effort to return to business and shake off lethargy and laziness.

In cases of concussion of the spinal cord or brain, of course the first necessity is absolute quiet and rest in bed, and, if there is no doubt about the correctness of the diagnosis, the surgeon should insist on a much longer rest than the patient is often disposed to take.

Where there is localised tenderness of the spine, stimulating liniments and unguents (especially oleate of mercury) do good. Blisters and the actual cautery may sometimes be applied with much benefit, but in hysterical and nervous cases they are not to be recommended. Where there are symptoms of inflammatory changes taking place in the cord, iodide of potassium and bichloride of mercury in small doses are beneficial. In spinal anemia it is found that iron, arsenic, strychnine, and quinine may be given with good effect, and, where paralysis has occurred from this cause, a course of galvanism with the slowly interrupted current should be tried. Where there are symptoms of meningeal inflammation of the brain or spinal cord, the writer has found grain doses of calomel and extract of aconite relieve pain and spasm in a marked degree. THOMAS BOND.

RANULA.—The term 'ranula' has been employed, somewhat loosely, to indicate the various sublingual cysts which project into the floor of the mouth by the frænum. Such a tumour may originate in many ways—by dilatation of one of the excretory ducts of the sub-lingual or sub-maxillary gland, by enlargement of the sub-lingual bursa of Fleischmann, or by cystic transformation of the connective-tissue interspaces of the part; or it may be dermoid or hydatid in structure. It is desirable, however, to exclude the two last, reserving the name 'ranula' for tumours having the characters about to be described, until the advance of pathology and diagnosis enables us to dispense with the expression altogether.

Symptoms.—The true ranula appears as a soft fluctuating tumour beneath the

tongue, on one or other side of the frænum, encroaching more or less upon the buccal cavity, and often projecting in a downward direction to give rise to a prominence in the sub-maxillary region. It is smooth, bluish, and translucent, of globular or ovoid form, and its surface is often traversed by Wharton's duct. The contained fluid is more or less viscous, tasteless, transparent, and of a tint varying from the palest straw to a deep brownish-yellow; and is occasionally discoloured by the admixture of blood or pus.

When small, it causes little inconvenience, but it may attain such large dimensions as to interfere with deglutition, articulation, and even with respiration. In one case mentioned by the elder Cline, the patient was on the point of suffocation in consequence of the backward displacement of the tongue by a huge ranula, when a timely use of the surgeon's lancet averted the danger. The tumour may appear at any age and in either sex, and can rarely be traced to any exciting cause.

Pathology.—It was once believed that the majority of cases of ranula were due to dilatation of a portion of Wharton's duct behind an impacted salivary calculus, but it is now certain that such a condition is very exceptional, even where a competent source of obstruction has been found; and some authorities have gone so far as to deny its existence altogether. The researches of Recklinghausen tend to show that the tumour is nearly always developed at the expense of the ducts of the sub-lingual gland, behind an inflammatory constriction or closure of the lumen of the tube. It is not, however, a mere dilatation containing an accumulation of saliva, but a true cyst, differing, both in its structural characters and the nature of its secretion, from the gland from which it is derived.

The cyst wall consists of a capsule of connective tissue with elastic fibres and vessels, usually delicate, but sometimes of considerable thickness ($\frac{1}{25}$ th of an inch), and lined with a double layer of epithelium, of which the superficial cells are cylindrical and ciliated; and chemical analysis of the fluid reveals the presence of mucus and albuminate of soda, but neither ptyalin nor sulpho-cyanide of potassium. With these peculiar features, it might be doubted whether the condition really arises in the manner described, but Recklinghausen has succeeded, in some cases, in discovering the orifice of the gland-duct in the wall of the cyst.

The share taken by Fleischmann's 'sub-lingual bursa' in the etiology of ranula is

still uncertain. This anatomical structure may be demonstrated without difficulty in many subjects, and there is no reason why, like other bursæ, it should not occasionally give rise to a cystic tumour; but it cannot be said that any ranula has ever yet been proved to originate in this manner. It is probable that, in a case of the kind, the character and composition of the fluid and the structure of the cyst-wall would be found to vary from the description just given, as that of the typical ranula.

Treatment.—As a preliminary measure, a careful search should be made, by palpation, for a calculus or other source of obstruction, which must be removed if found; but should nothing of the kind be discovered, the surgeon has the choice of several methods by which he may attack the tumour directly.

(1) Complete excision of the cyst. This method was recommended by Marchetti in the early part of the present century, and more recently by Schuli and others, but has seldom been carried into effect. It is necessarily the most radical procedure, and it is less difficult than might be anticipated, as the cyst-wall adheres but loosely to the adjacent tissues. The floor of the mouth must be fully exposed; and after freely incising the tumour in its long axis, the cyst may be removed, partly by traction, partly by small curved scissors. The administration of chloroform must usually be dispensed with, owing to the risk of entrance of blood into the air-passages.

(2) Removal of a portion of the cyst-wall with the superjacent mucous membrane. The operation rarely effects its purpose, owing to the speedy closure of the gap, and is now employed chiefly as a preliminary to other measures.

(3) The establishment of a permanent fistula to allow the continual escape of the contents of the tumour into the mouth. Louth endeavoured to achieve this end by repeated cauterisation of the edges of the opening left by an excision of a portion of the cyst, but without success. Dupuytren's *bouton à chemise*, as modified by Reisinger—a short canula with a button-like plate at either end—was an ingenious device to attain the same object. One extremity of the instrument was inserted into the cyst, the other remaining in the mouth, while the intermediate portion prevented the closure of the wound and provided an exit for the escape of the fluid. Chelius and others have expressed satisfaction at the results, but it has generally been found that the movements of the tongue rendered

it difficult to keep the implement in place. A simpler and most effectual method is the insertion of a loop of silver wire, which will lie quietly in the floor of the mouth and act as a permanent drain.

(4) The obliteration of the cyst by inflammation. For this purpose many plans have been essayed, including setons, the injection of iodine and other fluids, cauterisation of the interior of the cyst after the excision of a portion of the wall, and plugging the cavity with lint or other material, plain or steeped in iodine or chloride of zinc solution; but although a cure sometimes follows the means adopted, the general rule is failure, with the occasional addition of troublesome inflammatory complications in parts outside the limits of the tumour.

SUB-LINGUAL DERMOID CYSTS are not often met with. They may be diagnosed from true ranula by their congenital origin (of which, however, it is not always possible to obtain a history), their comparatively slow growth, their greater firmness of consistency, and, especially, by the absence of translucency. They usually tend to project chiefly in the direction of the sub-maxillary integument. The appropriate treatment is excision.

HYDATID CYSTS in the position of ranula are extremely rare. It might be difficult to distinguish their nature before operation without a microscopic examination of the contents.

SUB-LINGUAL ABSCESSSES AND HÆMATOMATA may generally be recognised without difficulty by the history of the swelling, except where the suppuration or hæmorrhage has occurred within the cavity of a ranula. In cases of doubt, the diagnosis may be established by the examination of a portion of the fluid drawn off by a small aspirator (morphia injection-syringe) or a trocar and canula.

W. ANDERSON.

RAYNAUD'S DISEASE. See ARTERIES, Diseases of; GANGRENE.

REACTION.—When a patient recovers from a condition of collapse, he passes on into the state known as that of reaction. The time that elapses between the oncoming of the collapse and the commencement of reaction varies according to the amount and intensity of the former. The stages of reaction are various. In some cases, the patient will rapidly pass from one to the other, so that complete restoration of the impaired faculties is brought about in a few minutes; in other cases, reaction is

slow and improvement almost imperceptible, and complete restoration does not take place for days or weeks.

The *symptoms* of reaction are as follows:—The patient, who has been lying motionless on his back, evinces a desire to change his position; in many cases he soon begins to retch, and perhaps vomits. The pulse improves in volume, tone, and rapidity; the respirations become deeper, and are often sighing; the clammy skin becomes warmer, and the lips assume a redder hue, swallowing is more easily accomplished; the mental faculties are gradually restored, the patient takes notice of surrounding objects, and is able to answer questions rationally. In some cases, complete restoration now ensues without further complication; but in others, after some hours, feverish symptoms supervene, the skin becomes hot and dry, the face is flushed, the eyes are bright, and the mental faculties are all in a state of excitement. The pulse becomes rapid and jerky, the respirations hurried; the patient is restless, and complains of thirst and headache. The temperature also rises to a varying extent. In this condition the patient may remain for a time, varying from a few hours to one or two days. Recovery is often by crisis, and after a long sleep complete convalescence may quickly ensue. In yet other cases, however, worse symptoms may follow, and a condition of 'prostration with excitement' may result; the rapidity and weakness of the pulse increase, respiration becomes gasping and hurried, the tongue is dry and tremulous, the patient becomes restless, and often wildly delirious, the temperature rises, and no sleep can be obtained. Exhaustion gradually supervenes, the pulse becomes running, the delirium becomes of the low and muttering variety, and the patient dies in a state of coma.

The above symptoms may be thus explained:—In consequence of the collapse induced by the injury, there is necessity for increased action of the various vital organs in order to preserve life. But, in consequence of the weakness induced by the same injury, there is a want of power in the organs on which the call is made. If the want of power be excessive and the need of action great, there results 'prostration with excitement'; if power be sufficient, a reaction which soon accomplishes its purpose will ensue.

Treatment.—So long as reaction is not excessive, there is no indication for treatment. If it be excessive or prolonged unduly, the indications are—(1) to support the

patient's strength; (2) to moderate the excessive irritability of the vital organs. With regard to the first, stimulants must be sparingly given, and reliance placed rather on strong fluid nourishment, and nutrient enemata if vomiting be troublesome. The second indication is fulfilled by perfect rest and quiet, keeping the head cool, and giving opium or morphia in doses which are sufficient to produce the required effect, but which must be regulated according to the requirements of the case. Hyoscyamus and belladonna are also useful.

ANTHONY A. BOWLBY.

RECTOCELE—Prolapse of the posterior wall of the vagina. *See* VAGINA, Affections of the.

RECTO-VAGINAL FISTULA. *See* VAGINAL FISTULÆ.

RECTO-VESICAL FISTULA.—A communication between the rectum and the bladder, with usually the result of an escape of feces or flatus into the bladder or urethra, or of urine into the rectum.

It may be congenital, or be caused by accident, operation, or ulceration. If the rectum be imperforate at birth, this condition is sometimes complicated by an arrest of development of the perineal septum between the bladder and rectum, so that a more or less considerable opening exists, through which meconium or feces can pass into the bladder. If a free passage can be made in the normal situation into the bowel, the abnormal communication may subsequently close. If such a passage cannot be made, or if the recto-vesical communication persist, when a free channel has been made for the feces in the normal situation, Littré's operation should be performed.

The rectum may sometimes be incised in the operations for lithotomy. It is said to happen more frequently than lithotomists are aware of. If so, the wound generally heals speedily. But, if a permanent fistula result, urine will escape into the bowel, and cause irritation and excoriation. Dilatation of the anus will probably bring the rectal opening into view. If it be very small, the application of the actual cautery will suffice, but if it be larger, the edges should be freshened and united by sutures, as in the operation for recto-vaginal fistula. The patient should maintain a lateral or prone position, and any accumulation of urine in the bladder be prevented until union has resulted. If this procedure be not successful, a grooved staff should be intro-

duced into the bladder, and by division of the intervening structures upon it a perineal fistula established. The wound will then heal by granulation.

A similar fistula occasionally resulted from the now seldom practised operation of tapping the bladder through the rectum, in retention of urine.

In malignant disease of the rectum, perforation from ulceration into the bladder may occur. Diversion of the fæces by the operation of lumbar colotomy would be the most suitable treatment; for the escape of fæcal matter into the bladder would probably induce cystitis, and might also give rise to retention of urine from obstruction of the vesical orifice.

Tuberculosis of the anal channel may sometimes result in recto-vesical fistula. Or the disease may originate in the prostate or vesiculæ seminales, and by ulcerating in both directions produce this condition. In this form of the affection, flatus rather than fæces may pass into the bladder or urethra, and urine may escape into the anal passage. The general condition of the patient must determine the propriety of operative interference. The establishment of a perineal fistula, by which the urine would constantly drain into a portable urinal, might give some relief.

JEREMIAH MCCARTHY.

RECTUM, Injuries and Diseases of the.

The anus, from its superficial position, is liable to injury, like the rest of the surface of the body, from contusions, burns, and scalds. These do not require any special treatment or description. The orifice of the anus may be lacerated by the passage of large and hard accumulations of fæces, or of bones or similar substances which have been accidentally swallowed. As a rule these heal spontaneously, but in unhealthy subjects, or if bathed in irritating discharges, they may ulcerate. Attention to cleanliness, removal of the source of irritation, and the application of mildly stimulating lotions or ointments will suffice for treatment. In tedious or instrumental labour, pressure on the recto-vaginal septum may result in sloughing and the formation of a recto-vaginal fistula. Or, in the final effort of parturition, the perinæum may be ruptured, and if the laceration extend into the anus, incontinence of fæces will result. For the description and treatment of these conditions, *see* VAGINAL FISTULÆ; PERINEUM, Rupture of the.

Maniacs, idiots, and persons of depraved or weak intellect, sometimes introduce

foreign bodies into the rectum, with more or less injury to the part. Medical literature abounds in instances of this kind. The writer met with a case where a man, in a drunken freak, had thrust an ordinary beer-glass, bottom upwards, into his rectum. It had passed beyond the sphincter muscles, which had firmly contracted. When he applied for relief, after an interval of some days, the rim of the glass was embedded in a deep ulcerated groove in the mucous membrane, which greatly increased the difficulty of extraction. Such cases must be treated according to the conditions of each case, and will sometimes tax to the uttermost the ingenuity of the surgeon. Rough, unskilful introduction of bougies or enema-tubes may sometimes result in perforation of the rectum. If the perforation be below the peritoneum, perirectal inflammation and suppuration will probably ensue. But if the peritoneum be perforated, and especially if nutrient or cathartic enemata have been pumped into its cavity, death from shock or peritonitis will be the most probable consequence. If the injury be recognised at the time, dilatation of the anus and the internal administration of opium and mercury should be employed.

For malformations of the rectum *see* ATRESIA ANI.

The mucous or submucous tissue of the bowel is exceedingly rarely the seat of a *navoid* growth. Only two instances of this condition have been recorded, for which reference may be made to the *Lancet* and *Medico-Chirurgical Transactions* for 1883. When ulceration occurs, hæmorrhage to an even fatal extent may result. We can only direct attention to the possibility of this condition, and the treatment must be regulated according to the circumstances of each case.

Pain, tenesmus, constipation alternating with diarrhoea, the discharge of mucus, sero-purulent or sanious fluid, or of blood in varying degrees and combinations, are symptoms common to most diseases of the rectum. But, however clearly the history may indicate the nature of the affection, thorough and careful examination of the part must always be made. Patients, especially women, are sometimes most unwilling to submit to this. A surgeon ought never to yield to this objection, however natural. The writer has met with cases where the patient's life had been rendered miserable and the health seriously affected, from treatment directed in accordance with the statements of the patient, and without

examination of the part. Even when the cause may be seemingly apparent, as in fissure, piles, fistula, or the like, careful investigation will sometimes ascertain that these are only secondary results of some lesion higher in the bowel, or of some disease of the bladder or urethra.

Sometimes, especially in women, paresis of the muscular coat of the bowel results from long-continued and neglected constipation. This is known as *atony* of the rectum. From lack of expulsive power, the rectum is enormously distended with flatus or fæces. Careful regulation of diet, and the internal administration of the extracts of *nux vomica* and *belladonna* will usually ensure a restoration of the normal condition.

INFLAMMATION OF THE RECTUM. *See* PROCTITIS.

INFLAMMATION OF THE TISSUES SURROUNDING THE RECTUM. *See* PERIPROCTITIS.

NEURALGIA OF THE RECTUM.—This may be defined as an abnormal excitability of the nerves or nerve-centres of the rectum, and the symptoms vary greatly. Sometimes, patients complain of pain in some parts of the rectum, paroxysmal or constant, unaffected by defæcation, for which no objective cause can be ascertained. Such patients are not infrequently of a markedly hysterical or hypochondriacal temperament, and, in the absence of any local cause, the treatment must be directed to the improvement of the mental condition. When there is no evidence of such disposition, the symptoms may possibly be due to a small exostosis pressing on some of the nerves supplying the rectum, or to some localised affection of the brain or spinal cord. The nervous condition of such patients should be carefully examined. The cases are, however, very rare, and the treatment must be modified according to the circumstances of each case. In other patients, this abnormal excitability may manifest itself by an almost irresistible desire to go to stool at unseasonable or impossible times, without any natural occasion. This has been designated by Curling as irritability of the rectum. As the intestine is now known to abound in many varieties of micro-organisms, by whose influence different decompositions are excited in the contents of the alimentary canal, it is not impossible that some specially irritating substance may be produced from such a cause in the secretions or contents of the rectum. Relief has been experienced, in such cases, by washing out the rectum with lukewarm water, and weak carbolie lotions

might be tried, together with the internal administration of salicylic acid, by which the development of such micro-organisms is checked. But the mental condition has also great influence in these cases, as sometimes the irritability ceases or greatly abates when the patient is assured that he can, if necessary, satisfy his desires.

POLYPUS OF THE RECTUM.—A new growth from the inner wall of the rectum. It is sometimes *papillary*, but more frequently *follicular*. The papillary form consists of elongated papillæ studded with secondary papillæ, usually sheathed with cylindrical epithelium and presenting a tuft-like appearance. The follicular variety is an outgrowth covered with mucous membrane, and has well-developed Lieberkühnian follicles. Muscular and fibrous elements also enter into its formation, and, according to the predominant tissue in it, the growth may be classed as adenoma, myoma, or fibroma. Adenoma and myoma are usually met with in children and young adults, while fibroma occurs more frequently in adults. It has been suggested that this is the result of time, and that the mucous membrane of the young growth may atrophy, and the residue become indurated by chronic inflammation.

The rectal polypus is generally solitary, but may be multiple, and may vary from the size of a raspberry to that of a hen's egg. It is very rarely larger than this, but the multiple variety may, in the aggregate, be large enough to obstruct the bowel.

The *symptoms* also vary. Sometimes a polypus is unnoticed during life, and only discovered by accident on the post-mortem table. Usually, however, it causes a mucous catarrh or hæmorrhage. Bleeding from the rectum after defæcation, in a young child, if there be no accidental injury to account for it, is almost certainly indicative of the existence of a polypus. If the peduncle be of sufficient length, the tumour may be protruded through the anus in defæcation, and is sometimes retained in that position by spasmodic contraction of the sphincter muscles. It is thus exposed to injury, and may ulcerate or become inflamed, and will always cause a disagreeable sensation as if some foreign body were lodged there. It is sometimes associated with ulceration of the mucous membrane of the bowel, especially with the variety known as fissure of the anus. It may also induce prolapse of the bowel or be complicated with internal piles. Sometimes an internal pile, indurated by chronic in-

flammation, is clinically indistinguishable from a fibrous polypus. In the multiple form, the mucous catarrh and hæmorrhage may be so great as to seriously impair the patient's health. This disease greatly resembles the villous growths which sometimes occur in the bladder. They are very rare, but are sometimes met with in more than one member of the same family. The growths present club-shaped protrusions, in some parts closely aggregated, in others more isolated. They are very vascular, and microscopically are found to consist chiefly of glandular tissue. See VILLOUS TUMOURS.

The *diagnosis* can only be assured by digital and ocular examinations. In the event of the polypus having an attachment high up in the rectum, the examination should always be made immediately after an action of the bowels, when the tumour will be found either protruding from the anus or within reach of the finger. It could only be confounded with an internal pile, from which the history, situation, and pedicle will sufficiently distinguish it, except in the case of an indurated pile, which is practically a polypus and requires the same treatment. The multiple variety is unlike any other disease of the rectum, and when seen cannot be mistaken.

Treatment, in all cases, consists in ligature of the pedicle and abscission of the growth. Removal without ligature might cause troublesome hæmorrhage. If the pedicle be thin and soft, caution must be observed in applying the ligature, as the pedicle might be torn across and bleeding result. In order to bring the growth within reach of the operator, an enema of warm water is sometimes requisite. In the multiple variety, the growths are sometimes so closely aggregated as to render necessary the removal of the portion of mucous membrane from which they spring. This may be either cut off with scissors or by the galvanic *écraseur*. The more isolated growths should be ligatured and cut off like the solitary polypus. The growths are usually so numerous as to require more than one operation for their removal. The after-treatment in such cases would be the same as for internal piles. The removal of a solitary polypus usually requires no subsequent treatment.

STRICTURE AND OBSTRUCTION OF THE RECTUM.—Stricture of the rectum is an impaired distensibility of some part or parts of this portion of the bowel, caused by structural changes in its walls or in the tissues immediately surrounding it. It must be distinguished from obstruction of the rectum, which may be caused by the

lumen of the tube being more or less completely filled by benign or malignant new-growths from its walls, or else compressed by similar growths from the neighbouring viscera or structures. As both impede or prevent defæcation, they may be treated of in the same article, although their origin and pathology are very different.

Stricture may be annular or tubular, and may be situated at the anal orifice, or at the juncture of the anus and rectum, or of the rectum and sigmoid flexure. These are the most usual situations, but it may be at any part of the rectum. It is usually single, and double stricture occurs very rarely. It may be of congenital origin. If the rectum be imperforate at birth, and if perineal dissection be requisite to expose the lower end of the bowel, stricture of the anal passage not infrequently results, and this is inevitable if the mucous and cutaneous surfaces cannot be united at the time of the operation. Stricture of the anal orifice may result from undue removal of the skin in operating for piles or prolapse, or from cicatrization of deep ulceration caused by disease or accidental injury.

Syphilitic ulceration of the bowel may by cicatrization induce stricture. If the ulceration continue, the reflex irritation produced by it will enhance the effect of the stricture. Such ulceration frequently occurs at the junction of the anus and rectum, and in the portion of bowel immediately above this junction, but it may occur at any part of the rectum. Any ulceration of the mucous membrane, whether simple, dysenteric, or tubercular, may have a similar result; but this rarely happens unless the deeper structures in the wall of the bowel have been involved in the process. Chronic catarrh of the rectum, with cicatricial contraction of the submucous coat may also cause it, and pelvic cellulitis, induced by disease or inflammation of the pelvic viscera, may be another exciting cause. It may also result from cancer.

When a stricture has existed for some time, the bowel above it becomes distended. Its muscular coats are hypertrophied, and the mucous membrane is very frequently ulcerated. If perforation of the bowel ensue, recto-vesical or recto-vaginal fistulæ may result, or, from peri-rectal suppuration, fistulous channels may open in the perineum or surrounding parts. If the stricture be above the anus, the mucous membrane in the lower part of the bowel usually becomes congested and inflamed. Mucous or purulent catarrh, piles, prolapse, and

anal fistulæ are then very frequent complications.

The earliest *symptoms* of stricture are constipation and difficulty in defæcation. But, as these conditions may result from many causes, a stricture may have existed for some time unknown to the patient. If it be inaccessible to ocular or digital examination, the *diagnosis* may present difficulty. The passage of ribbon-shaped motions was formerly regarded as a characteristic symptom. But if the stricture be at the upper part of the rectum, the motions, if there be any, will not have this form, and 'ribbon-shaped' fæces may be passed without the existence of any stricture, if the muscular structure of the rectum be unduly irritable. Constipation alternating with fluid motions, or the habitual passage of pellet-shaped fæces, are better indications. But these conditions may be due to obstruction as well as stricture. Bougies are sometimes deceptive. A fold of mucous membrane or the promontory of the sacrum may arrest the progress of the bougie, and induce the assumption of a non-existent stricture. It is sometimes useful to introduce a well-warmed and pliant O'Beirne's tube, and to pump some water into the bowel as the tube is advanced. It is, however, liable to coil upon itself, and so cause error. In doubtful cases, bimanual examination may be employed in adults with advantage. For this the patient should be placed in the lithotomy position and completely anæsthetised. The bladder having been emptied, the sphincters of the anus should be dilated, and the operator's left hand, well oiled, should be cautiously passed into the rectum. With the aid of the right hand pressed firmly into the left iliac fossa, the upper part of the rectum may thus be thoroughly explored.

If the passage be only moderately constricted, attention to diet and the use of laxative purgatives may enable the patient to live in comparative comfort. But if there be ulceration, the stricture will always be liable to inflammation, and by œdema and congestion of the mucous membrane may completely obstruct the passage. It has also a natural tendency to contraction, and may thus ultimately produce retention of fæces. If, in this condition, operative interference be delayed, ulceration and perforation of the distended bowel may result, and cause rapidly fatal peritonitis. This ulceration very frequently occurs in the cæcum. The treatment of stricture will vary with its position and cause. If it be at the anal orifice, a plastic operation,

planned according to the circumstances of the case, sometimes effects a complete cure. If it be in the lower part of the rectum, dilatation may be employed. For this, laminaria tents are very serviceable. A tent of suitable size, with a long firmly attached tape loop, should, when lubricated with glycerine, be passed into the stricture and left there for twenty-four hours. When it is withdrawn, the passage will be found to be greatly enlarged, and the introduction every second day of a gum elastic bougie, well softened in warm water, will prevent a recurrence of contraction. The size of the bougie may with advantage be gradually increased. The bougie should not be introduced by the patient or any inexperienced attendant, for ill-directed efforts have in some cases led to perforation and a fatal result. If there be ulceration, appropriate treatment must be employed. But if it be extensive, the patient's comfort and prolongation of life will be best attained by the operation of left lumbar colotomy. As a regular daily evacuation can then be insured without discomfort, and as the ulcer will no longer be irritated by the passage of fæces, the patient's health will improve, the local pain cease, and the diseased surface be placed under more favourable conditions for repair.

Lumbar colotomy is also the best mode of treating strictures at the upper part of the rectum, and so inaccessible for dilatation, if they cause retention of fæces; and for all strictures complicated by recto-vesical or recto-vaginal fistulæ, or by perirectal sinuses opening on the perineum or adjacent parts. In some cases, when colotomy has been performed for persistent retention of fæces in consequence of a stricture at the upper part of the rectum, motions will, after a short time, again pass through the rectum. This results from relaxation of the stricture when no longer irritated by the accumulation of fæces above it, and by the straining efforts to expel them. If the condition of the rectum be curable, the lumbar opening may be closed when occasion for it has ceased. But, as a rule, it causes very little inconvenience, which is cheerfully endured by patients who have experienced the discomfort and danger of retention or difficult evacuation of fæces.

Forceful dilatation of rectal strictures by specially contrived instruments, or by water pressure, is very dangerous. The incision of the stricture in one or many parts, though advocated by some surgeons, does not appear to be free from danger of pyæmia or perirectal inflammation. Recently, linear

proctotomy has been performed, with alleged good results, for simple strictures near the lower end of the rectum. For this purpose, a suitably curved trocar and canula should be introduced into the rectum, passed through the wall of the bowel above the stricture in the median line posteriorly, and through the cutaneous surface below the coccyx. The trocar having been withdrawn, the wire of an *écraseur* should be passed through the canula, and all the structures within the loop of wire slowly cut through. The galvanic *écraseur* may also be used for this purpose. The wound should be dressed in the ordinary way, and allowed to heal by granulation.

Obstruction of the rectum, due to growths within the bowel or to pressure from without, will cause symptoms similar to those of stricture. Very rarely, a large fibroid polypus may be the cause, or more rarely still some other benign growth. Syphilis may sometimes produce it by broad outgrowths from the mucous membrane. Cancer of the rectum is a frequent cause, and, in these cases, sometimes stricture and obstruction from new growths are combined. Malignant disease of the bladder, or uterus and ovaries, sarcoma of the sacrum, or even hydatid tumours, may occasion obstruction. When a fibroid polypus or other benign growth exists, it should be removed in the appropriate manner. Obstruction from syphilis should be treated with anti-syphilitic remedies, and, if relief be not speedily derived, colotomy should be performed. In obstruction from any other cause, colotomy will be necessary to relieve the immediate retention of fæces, and in some cases as a preliminary to further operations, such as excision of the lower part of the rectum. When the obstruction is due primarily to disease of the uterus, the possibility of obstruction of the cæcum or some part of the small intestine as well as of the rectum, should be remembered, and careful examination of the abdomen be made by percussion and palpation; so as if possible to determine whether left or right lumbar colotomy or enterotomy would be the most suitable procedure.

ULCERATION OF THE RECTUM.—The mucous membrane of the rectum is liable to ulceration from many causes. The passage and presence of fæces or flatus have no injurious effect on the normal mucous surface. But, if there be any lesion of this surface, the deeper structures do not possess this immunity, and may thus become the seat of inflammation and suppuration from the irritation of fæcal matter or of intestinal

gases. Simple ulcers may therefore result from wounds caused by fish-bones or the like, which have been accidentally swallowed, or by roughly introduced enema-tubes or other instruments.

Chronic catarrh may, by long-continued maceration, render the mucous surface liable to abrasion and so induce ulceration. The solitary lymphoid glands of the rectum are, like those in the other parts of the intestine, liable to inflammation and suppuration, and if the resulting abscesses burst into the rectum, funnel-shaped ulcers of minute size will result. These, if many in number and close together, may become confluent, and so cause destruction of a considerable extent of mucous surface.

Dysentery, tuberculosis, syphilis, and malignant disease of the rectum, frequently produce ulceration.

Leucorrhœal or other vaginal discharges may also cause ulceration of the anal orifice or passage.

Follicular, dysenteric, and tubercular ulcers are not limited to the rectum, and affect a more or less considerable extent of the rest of the intestine. They belong, therefore, to medical rather than surgical practice, and surgical interference is only required if perforation of the rectum has occurred, when pelvic cellulitis, ischio-rectal abscess, and perineal, recto-vesical or recto-vaginal fistulæ may result.

The *symptoms* of simple ulceration will vary with the situation of the ulcer. If it be at the orifice or in the anal passage, the patient will probably experience pain in defæcation, and there may be great spasm of the sphincter muscles. There will always be a discharge of muco-purulent or purulent fluid, and sometimes of blood. If the ulcer be above the anus, there will not usually be any pain, and the discharge alone will indicate that the condition of the part is abnormal. Digital and ocular examination must ascertain the cause. Sometimes, an ulcer may exist without the patient being in any way aware of it.

The *treatment* is sufficiently simple. Attention to diet, mild laxatives, and iodoform in powder or as an ointment, or cotton wool steeped in a two per cent. solution of nitrate of silver applied locally, will usually ensure healing. If there be much pain or spasm, forcible dilatation of the anus when the patient has been anæsthetised will produce temporary paresis of the sphincter muscles, and so expedite the case by relieving pain. If the ulceration result from chronic catarrh, the exciting cause

must be removed and then the above treatment employed.

Syphilitic ulceration may occur in any stage of the disease. The anal orifice or passage may be the seat of a primary sore from accidental infection or unnatural intercourse. It will cause pain in defecation, and may from irritation by faecal matter become very large. The induration and the indications of syphilis in lymphatic glands, &c., will render the diagnosis easy. Ordinary anti-syphilitic treatment will, with attention to cleanliness, suffice. Phagedenic ulceration must be treated, as elsewhere, by cauterisation with nitric acid or chloride of zinc, hot baths, poultices, tonics, and abundant nutriment.

The loss of tissue is considerable, and stricture of the orifice generally results. This must be treated by dilatation or a plastic operation, according to circumstances.

In the secondary stage, mucous papules in the anus or condylomata round it may, in unhealthy subjects, suppurate and produce extensive serpiginous ulceration. Iodide of potassium in five-grain doses, hot baths, iodoform in powder, and, if necessary, cauterisation with nitric acid will be the suitable mode of treatment.

In the tertiary stage, the lower part of the rectum is, especially in women, a frequent seat of syphilis. The submucous tissue may be uniformly infiltrated so as to produce rigidity and stenosis of the bowel, or gummata of large size may cause projections into the lumen of the tube, or numerous minute gummata may form and gradually extend for a considerable distance up the rectum. Ulceration of the mucous membrane speedily ensues. The patient will suffer from obstruction or stenosis of the bowel. The discharge of sanious, offensive fluid is abundant, and the pain is often very severe. Perforation into the vagina frequently occurs. The diagnosis is often very difficult. A history of syphilis or evidence of the disease in other parts of the body may indicate the nature of the case; but, when the distance is extensive, it does not yield readily to anti-syphilitic treatment. In such cases lumbar colotomy would be most suitable, and, the ulcerated surface being no longer irritated by the passage of faeces, would be more likely to heal. In less severe cases, irrigation with dilute Cond's fluid, and the internal administration of decoction of bark with biniodide of mercury, will be found beneficial. One-drachm doses of the liq. hydrargyri bichloridi, with five-grain doses

of the iodide of potassium, will be found to be a most convenient method of administering the biniodide of mercury.

MALIGNANT DISEASE OF THE RECTUM.—The mucous membrane of the rectum at, and for some extent above, its junction with the anus, is not infrequently subject to hyperplasia. This at first results in considerable enlargement of Lieberkühn's follicles, and, as secondary consequences of irritation, hypertrophy of the tunica mucosa muscularis and infiltration of the submucous tissue with leucocytes. The growth may be greater at some parts of the circumference of the bowel than at others, with the result of irregular projections into the lumen of the tube. There is also increased vascularity. If this be all, the growth is benign, and forms the superficial adenoma of Klebs. But, if the continuity of the membrana propria or basement membrane be broken through, and if the epithelial cells grow or pass along the lymph-channels among the component elements of the other structures of the bowel, it becomes true cancer. The immigrant cells form centres for new epithelial growths, which produce, by irritation, changes in the surrounding structures. These growths contribute to the obstruction of the bowel, and by pressure may produce atrophy and ulceration of the mucous surface. The disease may in this manner extend along the bowel, or invade the perirectal tissues and neighbouring organs, such as the vagina, prostate, or bladder. If perforation of the bowel ensue, ischio-rectal suppuration and perineal sinuses may result, or fistulous communications form into the vagina or bladder. The lymphatic glands in connection with the bowel, and the liver through the portal system of veins, may be the seat of secondary growths, and cancerous cachexia ensue.

If the irritative process predominate in the growths, scirrhus will result, with induration and contraction of the walls of the bowel. This variety of cancer does not occur frequently in the rectum. If the epithelial growths form the chief part, the cancer is soft or encephaloid. In this variety there is less induration and contraction, but the lumen of the bowel is obstructed by large, very vascular growths, which are sometimes of the cauliflower form and are very liable to slough. The epithelial new-growth tends to develop according to the type of the normal epithelium of the part from which it is derived. Microscopic examination of soft cancer of the rectum usually discloses, therefore, a

tubular structure, the tubules being sheathed with a single layer of cylindrical epithelial cells, and resembling Lieberkühn's follicles. This constitutes what is known as cylindrical-celled or adenoid carcinoma or epithelioma. Colloid cancer will result from the corresponding degeneration of the epithelium, so that elements of the new growth resemble boiled sago-grains embedded in the surrounding indurated tissues. Melanosis also sometimes occurs in the rectum.

The *symptoms* are at first very indefinite. As the disease is usually painless until ulceration has taken place, constipation and difficulty in defæcation are the first indications. When ulcers form, discharge of sero-purulent or sanious fluid or of blood will occur, but, if the case be complicated with piles, the source of the discharge may be mistaken. Careful exploration of the rectum should therefore be made in all cases of constipation or of purulent or other discharge from the bowel. When the growth presses upon the nerves of the sacral plexus, cramps and painful sensations in the lower extremities are often experienced. If the bladder or prostate be involved, there may be difficulty in micturition, and the passage of fæces into the bladder through a fistulous opening will very probably produce cystitis. As the ulceration progresses, pain in defæcation increases, and complete obstruction of the bowels often results; partly from the occlusion of the tube by growths or by contraction, and partly from the arrest of peristalsis, in consequence of the muscular fibres of the bowel being destroyed or impaired. The rate of progress will vary with the nature of the cancer. In the firm, contracting variety, it is much less rapid than in the encephaloid form.

Cancer of the other pelvic viscera may, by direct continuity, invade the rectum. In such cases, obstruction of the bowels will, so far as regards the rectum, usually be the chief symptom.

The anal passage is sheathed with squamous stratified epithelium, and the external orifice is abundantly supplied with anal glands. The epithelium of these glands, or of the rete mucosum, may be the starting point of new growths. When these have perforated the basement membrane, epithelioma of the anus is the result. It usually commences as a small nodule or wart, which has sometimes been mistaken for an external or intermediate pile. The surface, however, soon becomes fissured and ulcerated, and bleeding or sanious discharge results. The disease generally extends along the cuta-

neous surface round the anus, but it may also pass up the bowel, or in both directions simultaneously. Anal epithelioma is much more painful than rectal cancer. The pain during defæcation is very severe, and it is also more constant than in the rectal disease, and often radiates to distant parts.

The *diagnosis* of malignant disease of the rectum does not usually present much difficulty. Syphilitic ulceration is alone likely to be mistaken for it. The margin of the anus is sometimes from accidental infection, or from unnatural intercourse, the seat of a primary syphilitic sore. If this be of an unhealthy character, it may very greatly resemble an epitheliomatous ulcer. But anal epithelioma is usually an affection of advanced life, and primary syphilis would probably occur in younger persons. The history of the case, the presence or absence of other indications of syphilis, and the result of antisiphilitic treatment, in doubtful cases, should render the diagnosis certain. Syphilitic ulceration of the rectum is not so readily distinguishable from cancer. The lower part of the rectum is a frequent seat, especially in women, of tertiary syphilitic growths, which may be of sufficient size to considerably obstruct the tube, and when ulceration ensues the resemblance to cancer is very great.

Some writers suggest microscopic examination of shreds detached from the ulcerated surface as a diagnostic means; but while it might possibly corroborate a diagnosis formed on other grounds, in really difficult cases it would not be of much service, and the suggestion appears to be theoretical rather than practical. The history of the case, the general condition of the patient, and the effect of antisiphilitic treatment would form the best grounds for a diagnosis; and in bad cases, the palliative treatment of lumbar colotomy would be the same for both affections.

Treatment.—Anal epithelioma must be freely removed as in other parts of the body, unless the disease has progressed too far to admit of operation. If the growth be limited in size and superficial, it may be at once excised, and hæmorrhage arrested by ligature of vessels or by the actual cautery. Iodoform in powder would be the best subsequent application. But if the extent of the disease requires the removal of a portion of the anal wall, the passage should be forcibly dilated, and a curved incision of suitable extent should be made in the healthy skin corresponding in situation to the part that is to be removed. The dissection

should then be carried up through the perineal tissues, until the upper limit of the growth has been passed, and the diseased portion removed by the ordinary or galvanic *écraseur*, or with the knife or scissors, according to the circumstances of the case and the predilection of the operator.

When the anterior wall has to be removed, the introduction of a full-sized metal catheter into the bladder will be of service in indicating the position of the urethra and prostate gland. If the whole of the anus must be removed, the incision must be made correspondingly, and the isolated bowel excised with the *écraseur*. Some recommend the preliminary insertion of ligatures a little above the proposed line of excision, which may afterwards be used to unite the mucous and cutaneous surfaces. If this can be accomplished, the liability to subsequent stricture will be greatly diminished; but, as a rule, the tension of the parts is such as to cause the sutures to cut through and be useless.

Cancer of the rectum has latterly, owing to the enterprise of Continental and more recently of English surgeons, been treated by operation much more than was formerly deemed possible or justifiable. Experience has proved that three or four inches in length of the bowel can be removed with safety at the time of the operation, and with the result of complete cure in some cases, and of great amelioration in others. The indications for removal are that the upper limit of the growth should be accessible, and should not be so far from the anal orifice as to endanger wounding the peritoneum during the operation; and that the disease should be limited to the rectum and not involve the other pelvic viscera. The absence of secondary growths in lymphatic glands or in the liver should also, so far as possible, be ascertained. These conditions being fulfilled, an extension upward of the dissection required for removal of the anus until the upper limit of the growth has been passed, and the removal of the isolated bowel by the *écraseur*, would suffice. Attempts to unite the mucous and cutaneous surfaces are useless. Opening the peritoneal sac very seriously affects the chance of a successful result. In order to so far as possible prevent this occurrence, the bladder should be distended by injections of water, by which the recto-vesical fold of peritoneum would be considerably elevated. If it should be wounded, the aperture, if small, should be closed by a ligature, and, if large, a drainage-tube should be inserted,

and opium freely administered. In all such operations, and also when the whole or a large part of the anus is to be removed, lumbar colotomy is, in the writer's opinion, most advisable as a preliminary. When this has been performed, a daily painless evacuation can take place, the nutrition of the patient is not interfered with, the ulcerated bowel is no longer irritated by the passage of feces, or by the existence of fetid gases resulting from the fermentation of retained feces; and the wound caused by the subsequent operation is also free from such noxious influences.

In some cases, a portion only of the wall of the rectum will require removal. This can be accomplished after forcible dilatation of the anus, or division in the median line posteriorly of all the tissues from the mucous membrane to the skin, extending as high as the tip of the coccyx. The requisite portion of the rectum can be removed with scissors or the *écraseur*. Incontinence of feces is not very frequently a result of these operations.

In cases where removal of the growth is impossible, lumbar colotomy will be the best palliative treatment. Careful irrigation of the rectum, with carbolic acid solution or with diluted Condy's fluid, should also be employed. Scraping the ulcerated surface, and subsequently applying the actual cautery to it, are sometimes of service, and appear, for a time at any rate, to promote a growth of healthy granulation-tissue.

Sarcoma seldom occurs primarily in the rectum, but may invade it from other surrounding parts. It is not impossible that some of the recorded cases of encephaloid cancer may really have been sarcomata, in the days when the microscopic characteristics of both kinds of growth had not been so clearly distinguished as they have been in later times. The treatment would be the same as for cancer.

See also FISSURE OF THE ANUS; FISTULA IN ANO; HEMORRHOIDS; PERIPROCTITIS; PROCTITIS; PROLAPUS ANI ET RECTI; PRURITUS ANI; RECTO-VEsICAL FISTULA.

JEREMIAH MCCARTHY.

REDUCTION EN BLOC, or EN MASSE. *See* HERNIA, Strangulated.

REFRACTION, Errors of.—In this article the following abbreviations are employed:—A., accommodation; As., astigmatism; D., dioptre; E., emmetropia; F_h, horizontal focus; F_v vertical focus; H., hypermetropia; M., myopia; V., vision;

+^{va}, convex; -^{va}, concave; <, less than; ', one foot or one minute; ", one inch or one second; ∪, combined with.—The function of the refracting apparatus of the eye is to bring rays proceeding from external objects to a focus on the sentient layer of the retina, and thereby give a distinct image of such objects. The calculation of the passage of rays of light through the various media of the eye—cornea, lens, &c.—is a very complicated one; in order to simplify it, it has been proposed to substitute for the actual eye a diagrammatic one consisting of a single refracting surface, bounded anteriorly by air and posteriorly by vitreous humour. The dimensions of such an eye have been fixed by Donders as follows:—Radius of curvature of the single refracting surface (the cornea) = 5 mm.; total length of the eye from cornea to retina = 20 mm.; distance of nodal point behind the cornea = 5 mm.; index of refraction = $\frac{4}{3}$. It will

be seen that the nodal point coincides with the centre of the cornea. This goes by the name of the 'reduced eye' of Donders; with it calculations about the optical properties of the eye are very simple, and the results are so nearly correct as to suffice for all practical purposes.

The relation between the refractive power and the length of axis of the 'reduced eye' is such, that parallel rays falling on the cornea are brought to a focus on the retina. Such an eye is called *emmetropic*, or is said to be in a condition of *emmetropia* (E.). This relation may be disturbed, so that the focus of entering parallel rays is either (1) anterior to the retina or (2) posterior to it; in the former case the eye is called *myopic*, or is said to be in a state of *myopia* (M.); in the latter the eye is called *hypermetropic*, or is said to be in a state of *hypermetropia* (H.).

In neither of these cases is a distinct image of a distant external object formed on the retina; the image of any point of such an object is not a point on the retina, but a circle of diffusion, the rays proceeding from the external point having come to a focus before reaching the retina in (M.), or being on their way to a focus behind the retina in (H.). In both cases the image of the external object is a number of overlapping circles of diffusion, and is therefore blurred.

There is a third anomalous condition of the eye, in which the image on the retina of an external point is not itself a point; this is the affection known as *astigmatism* (As.), which we shall describe later on.

These three departures from *emmetropia*—viz. *myopia*, *hypermetropia*, and *astigmatism*—are what we have to consider. They are often collectively described as *ametropia*.

Before the description of these affections a few words must be said about—(1) *the numbering of lenses*; (2) *the accommodation of the eye*; (3) *the determination of the acuity of vision*.

Numbering of Lenses.—Till a few years ago, lenses were numbered according to their *focal length*, generally expressed in inches, and the unit of measurement taken was a lens whose *focal length* was one inch, and whose *focal power*, therefore, being the reciprocal of the focal length, would be expressed by unity. Nearly all other lenses with which oculists have to deal are of a longer focal length than one inch, say twelve or twenty inches. The focal power of these lenses would be expressed by fractions $\frac{1}{12}$ and $\frac{1}{20}$ in the cases we have chosen for illustration. Working out combinations of these lenses necessitated much troublesome calculation of fractions. To avoid this, as well as other disadvantages, the *metrical system* of numbering lenses has been suggested, and is now almost universally adopted.

Here the unit of measurement is a lens whose focal length is 1 mètre. The focal power of this lens is called a *dioptre* (1 D); shortly, the lens itself is called a *dioptre*. A lens of twice the refractive power, and whose focal length is therefore half a mètre, is called 2 dioptres (2 D). A lens of half the focal power of the first will be .50 D, and have a focal length of 2 mètres, and so on. The focal lengths are better expressed in centimètres; thus the focal length of a lens of 1 D is 100 cm.; of 2 D, 50 cm.; and generally the focal length of a lens is found in centimètres by dividing 100 by the number of the lens in dioptres; and conversely the focal power of a lens is found in dioptres by dividing 100 by the number of centimètres in the focal length.

For example, take a lens of 5 D; what is its focal length in centimètres?— $\frac{100}{5} = 20$;

therefore the focal length is 20 cm.

Again, what is the focal power of a lens of 40 cm. focal length?— $\frac{100}{40} = \frac{5}{2} = 2.50$;

therefore the strength of the lens is 2.50 D.

Of course the signs + and - are prefixed to numbers denoting the strength of the lens according as the lens is convex or concave.

To convert from inches to dioptres is equally simple. Only English inches will

here be referred to. A mètre = 40 in. nearly; therefore a lens of 1 D has focal length of 40 in., and therefore a focal power of $\frac{1}{40}$, according to the old notation. A lens of 3 D is three times as strong as the first; therefore its focal power, according to the old notation, is $\frac{3}{40}$, and its focal length $\frac{40}{3} = 13\frac{1}{3}$ in.

The general rule is: to find the number of D in a lens, divide 40 by its focal length in (English) inches; to find the focal length of a lens in (English) inches, divide 40 by the number of D in the lens.

Thus a lens whose focal length is 12" is $\frac{40}{12} = 3.5$ D (nearly); and a lens of 7 D has

a focal length = $\frac{40}{7} = 6''$ (nearly).

In the following article lengths will, as a rule, be expressed in mètres and centimètres; occasionally the equivalent in feet or inches being given. It is useful to remember that, approximately, 1 mètre = 40";

1 cm. = $\frac{2''}{5}$; 1 mm. = $\frac{1''}{50}$.

ACCOMMODATION (A.).—All eyes have the power of increasing by a muscular effort their refractive power; this is known as the power of accommodation. This is not the place to discuss the physiology of the act; all we are concerned with is the measure of it. Donders showed that the amount of accommodation was independent of the refractive condition of the eye, and depended only on the age of the individual. It is very convenient to imagine that the eye, in calling into action its power of accommodation, takes to itself an auxiliary convex lens, the strength of which equals the increase of refractive power caused by the accommodative effort. This auxiliary lens ought, strictly, to be imagined as being placed in the position of the nodal point of the eye, but we may, without an error of practical importance, suppose it placed in front of the eye, in the position of an ordinary spectacle-glass. This way of looking upon accommodation, as a power residing in the eye of placing in front of itself a magnifying glass of suitable strength, will be found very useful when we come to examine the various errors of refraction.

The strength of this imaginary auxiliary lens is best expressed in dioptries.

The greatest amount of accommodation an eye can exert is called its *amplitude of accommodation*.

Donders drew up the following table of the amplitude of accommodation possessed by the eye at different ages:—

Age	Amplitude of Accommodation	Age	Amplitude of Accommodation
10 years	14 D	40 years	4.5 D
15 "	12 D	45 "	3.5 D
20 "	10 D	50 "	2.5 D
25 "	8.5 D	55 "	1.75 D
30 "	7 D	70 "	.25 D
35 "	5.5 D	75 "	0.00 D

In making the experiments on which this table is founded, the eye was tested alone, without the co-operation of the other eye. This is hence called the *amplitude of absolute accommodation*; when both eyes are uncovered, the *amplitude of binocular accommodation* is obtained. This is somewhat different from the results in the above table. See ACCOMMODATION OF THE EYE.

DETERMINATION OF THE ACUITY OF VISION.—The standard proposed by Snellen, and now generally adopted, is that a letter should be recognised, under proper illumination, when it subtends an angle of 5', the breadth of its limbs being one-fifth of its height, and therefore subtending an angle of 1'.

A scale of test-types has been constructed on this principle by Snellen. The scale consists of a series of rows of square Roman letters; each row has a number, which expresses in mètres the distance at which the letters in the row are seen under an angle of 5', and should therefore be recognised by a normal eye.

A special card is made for testing the sight at a distance so considerable that rays diverging from a point at that distance may be considered parallel. This card has seven rows of letters, which bear the numbers 60, 36, 24, 18, 12, 9, 6; it is most conveniently placed at a distance of six mètres (about twenty feet), that being the distance at which the letters of the row 6 should be made out. The acuity of vision (for which the symbol v is commonly used) is expressed by a fraction, of which the numerator is the distance at which the card is placed—viz. six mètres, and the denominator the number appended to the smallest row of letters which can be read.

Thus, if the smallest row of all is read, $v = \frac{6}{6}$; if row 12, $v = \frac{6}{12}$, and so on. If the types be placed at a different distance, it will be necessary to alter the numerator; for instance, if they be placed at four mètres, and the row 9 of the above card be the smallest read, $v = \frac{4}{9}$; at this distance we

have no types on the card small enough to express unity, which represents the standard of distinct vision; to do this, we should have to add to the card smaller letters still. It is immaterial what distance be chosen, so long as it is great enough for rays proceeding from that distance to be practically parallel; but six mètres, having come into general use, may be conveniently adopted for the sake of uniformity. Before the metrical system was generally adopted, distances were expressed in feet, and the numbers appended to the rows of letters correspondingly altered. Thus the row of largest letters was No. 200, the others being 100, 70, 50, 40, 30, 20.

In this case, the row of smallest letters being seen at twenty feet, v would be $\frac{20}{20}$

instead of $\frac{6}{6}$ as above; decreasing acuity

of vision would be expressed by $v = \frac{20}{30} = \frac{20}{50}$,

and so on, corresponding to $v = \frac{6}{9}$, &c.

In addition to the distance-test, eyes are often examined with smaller types at short distances; for this, Snellen's series may still be used; but the types of Jaeger are generally preferred. These are numbered 1, 2, 4, up to 20. In testing the sight, the number of the type that is read, and the distance at which it is read, should be noted.

It is necessary to ascertain not only what the unaided eye can read, but also what help lenses afford. For this purpose the surgeon should be provided with a case of test-glasses. This contains a series of pairs of convex lenses of increasing strength, from .5 D up to 20 D; a similar series of concave lenses, convex and concave cylindrical lenses, prisms, trial frames, &c. Each eye should be tested, and the result noted, separately.

It will be found a great saving of time to set to work methodically; the following procedure is recommended:—A trial frame is fitted on the patient's face, and an opaque disc placed in front of the left eye, so that the right eye is uncovered for testing. The patient is then invited to read Jaeger's No. 1, holding the types at any distance he chooses; if he fails to read Jaeger 1, he is tried with Jaeger 2, 4, &c., still at his own distance, till the smallest type he can read is found. This is noted, and also the distance at which he holds it for reading. Not much stress need be laid on this reading of *near* types as a test of acuity of vision; a presbyope, for instance, with perfect acuity of vision,

might not be able to read even large letters near at hand unaided by convex glasses.

The test is now continued with the *distant* types. And here it should be explained that, in ophthalmic works, a *distant* object means any object that is so far distant from the eye that rays proceeding from it may be considered to enter the eye practically parallel. This distance is conventionally put at about six mètres; in the following pages we shall then mean by a *distant* object an object at about six mètres.

The patient is accordingly invited to read Snellen's card of types placed at six mètres; he is told to begin at the row of largest letters, and read the other rows upwards or downwards as the case may be; the result is then noted. Further, the effect of putting + and - glasses in the trial frame is noted; but we must wait till the errors of refraction have been discussed before this effect can be appreciated. Suppose the patient reads Jaeger's 2 at 10", and at six mètres row 9; the result would be thus noted—

R.E. (right eye.)

J. 2 at 25 cm.

$$v = \frac{6}{9}$$

If we wished to examine the *near* vision more closely, we ought to find his near and far point. In the above case, for example, the patient might be able to bring J. 2 up to within 10 cm. of his face, and still read it, or remove it to 30 cm., and still see it.

This might be noted thus: J. 2, 10 cm.—30 cm. In finding the far point, care must be taken to test the eye with print adapted to the distance of that point from the eye. Thus, J. 1 is too small to be seen by an eye of good visual acuity at a greater distance than 35 or 40 cm. Beyond this distance larger print must be used. *See VISUAL ACUITY.*

The various errors of refraction may now be discussed; these being (a) *myopia*, (b) *hypermetropia*, (c) *astigmatism*.

(a) *MYOPIA*.—Here parallel rays come to a focus in front of the retina. This may arise either from an increase of refractive power in the dioptric apparatus of the eye, the entering parallel rays being consequently bent more abruptly, or from an increase in the length of the eye. It is usually due to the latter cause—the axis of the eye is too long. It is convenient, however, to consider it as depending on an increase in the refractive power of the eye; as it is only the *relation* between these two factors that we are concerned with, this way of viewing the matter is practically correct

We say, then, that in M. the refractive power of the eye is too great. We may imagine that a myopic eye is an emmetropic eye armed with a convex lens in front of itself, just as we did in considering accommodation. The strength of this hypothetical lens will then express the amount of M. For instance, in M. of 4 D, this lens is 4 D; this will make parallel rays diverging from its principal focus—i.e. from a distance of $\frac{100}{4}$ cm.; such parallel rays entering, then, the emmetropic eye, which we have considered combined with the convex lens to form the myopic eye, will be brought accurately to a focus on its retina, and therefore an external object, at a distance of $\frac{100}{4}$ cm. from this myopic eye, will be seen distinctly. Objects at all other distances will be seen indistinctly, so long as the accommodation of the eye remains at rest.

A myopic eye, however, has the power of accommodation like any other eye; this power, we have seen, is equivalent to placing in front of the eye a convex lens, of the strength necessary to focus on the retina rays from any object which such an eye can possibly see. It is evident that all objects situated farther from this myopic eye than $\frac{100}{4}$ cm. are out of its range of distinct

vision. Rays from such objects are already brought to a focus in front of its retina; the calling into action of the power of accommodation would only bring them to a focus still farther in front of the retina, and consequently make the images more blurred. It is different, however, with objects situated nearer the eye than $\frac{100}{4}$ cm.; rays from

such objects unite behind the retina, and an appropriate convex lens will bring them exactly to a focus on it; this lens the eye, bringing into play its accommodation, automatically selects when a distinct image of such objects is desired. There is a limit, however, in this direction also. An eye has at its disposal only a certain amount of accommodative power, expressed by a convex lens of a certain number of dioptries; this must not be exceeded.

An example may make this clearer. Keeping still to the eye with M. = 4 D, let us suppose that the amount of accommodation at its disposal = 6 D. Then, with A. altogether in abeyance, the eye will see distinctly only objects at a distance of $\frac{100}{4}$ cm. Suppose now it calls into play 2 D of its A.; it is then

in the position of an emmetropic eye with a lens = +6 D in front of it [4 D for the M. and 2 D for the A.]. The eye then will see objects distinctly at a distance of $\frac{100}{6}$ cm. If 5 D of its A. be used, objects will be seen distinctly at $\frac{100}{4+5} = \frac{100}{9}$ cm.

If the whole of A.—i.e. 6 D—be called into use, the only distance of distinct vision will be $\frac{100}{4+6} = 10$ cm. This is the nearest point of distinct vision. The farthest point of distinct vision is, as has been shown above, $\frac{100}{4} = 25$ cm. This eye, then, has a range of distinct vision between the distances of 10 cm. and 25 cm. measured from itself.

The nearest point of distinct vision is called the *punctum proximum*, or *near point*, and its distance from the eye is denoted by P; the farthest point of distinct vision is called the *punctum remotum*, or *far point*, and its distance from the eye is denoted by R; R-P is then the distance over which the eye has distinct vision, and $\frac{100}{P} - \frac{100}{R}$ = the number of D in the amplitude of accommodation [P and R being expressed in cm.].

Moreover, the lens which expresses the amount of M. is that whose focal length = R, and which therefore = $\frac{100}{R}$ D.

Etiology.—M. does not often appear before the eighth or ninth year; it generally progresses till adult age is reached. It is frequently hereditary, but may be induced by constant use of the eyes on very fine work, as that of watchmakers, &c. It is relatively common amongst the more civilised communities, and the more studious sections of those communities. M. occurs very frequently in those who have had defective sight from childhood; this is probably due to their constantly bringing objects close to the eyes, in order to get large retinal images. Any disease which causes increased curvature of the cornea will also cause M.; the most remarkable instance of this is 'conical cornea.'

The amount of M. varies within wide limits; up to 4 D would be called a low grade; 10 to 12 D is a pretty high amount, but much higher degrees occur—up to 20, 25, and even 30 D. The amount is often not the same in both eyes.

Symptoms.—In the low degrees, the only inconvenience is, usually, that the patient

cannot distinctly see distant objects. For near ones the sight is uncommonly good; in looking at distant things the myope partially closes the eyelids in a very characteristic manner; in this way he is able to narrow the circles of diffusion, and thus get a more distinct image.

In the higher degrees, the eye is seen to be decidedly too prominent; the patient complains of aching of the eyes on working, especially by artificial light; there is a constant feeling of tension; sometimes severe headache; flashes of light and *muscæ volitantes*. All these troubles are generally the greater the higher the degree of M.; they are worst of all when M. is rapidly increasing. In the high degrees there may be considerable diminution of the acuity of vision.

Diagnosis and Measurement.—If distant vision be improved by concave glasses, it is generally speaking a case of M.; sometimes, however, H. simulates M. This will be referred to later on. In examining a case where M. is suspected, it is most convenient to test the vision for near objects first. If the patient complains of very defective distant vision, whilst No. 1 of Jaeger's test types is read close at hand, it is almost certainly a case of M. To estimate the amount of M., find the *punctum remotum*—i.e. find the greatest distance at which the patient can read Jaeger 1 or 2. We have seen above that r is the focal length of the lens that measures M. Suppose, for instance, $r = 20$ cm.

$$\text{Then } M. = \frac{100}{20} D = 5 D.$$

But the accurate estimation of M. must be made with Snellen's large test-types at 6 mètres. A myopic eye, we have seen, may be regarded as an emmetropic eye armed with a convex glass, the strength of which is a measure of the M. We know the strength of this hypothetical convex lens, if we know the concave lens that neutralises it—i.e. brings the eye into the condition of an emmetropic one. Now the characteristic of an emmetropic eye is that it brings parallel rays to a focus on its retina, and therefore, if healthy, has the normal acuity of vision for distant objects, i.e.—has $v = \frac{6}{6}$.

We find, then, the weakest concave lens, which in the case of the myopic eye gives $v = \frac{6}{6}$; and this lens gives us the amount of M. It may be that no concave lens brings v up to $\frac{6}{6}$; in this case there must

be some other condition complicating the M.; some astigmatism, perhaps, or some degenerative change in the retina. Here we find the weakest concave lens, which gives the *best attainable acuity of vision* at 6 mètres, and this we take to be a measure of the M. It must be the *weakest* concave lens; with a stronger concave lens v might still be as good, but the lens would not represent the amount of M.; accommodation would be called into play to the amount necessary to correct the excess of strength of the lens; and this latter would represent not only the M. of the eye in a state of rest, but also the amount of accommodation so exercised. Take, for instance, an eye for which, with the small types, we find $r = 15$ cm.

This would give as a rough estimate $M. = \frac{100}{15} = 7 D$ nearly. We put up $-7 D$

in the trial frame, and find $v = \frac{6}{9}$; we hold up in front of this glass an additional $-1 D$; we now find that $v = \frac{6}{6}$. M. then $= 8 D$.

If now we put up $-8 D$ in the frame and hold an additional $-1 D$ in front of this, we may still find that $v = \frac{6}{6}$. It would

be an error to say, however, that $M. = 9 D$. What happens when we put up this additional $-1 D$ is this: $-8 D$ has brought the parallel rays coming from the test-types accurately to a focus on the retina, as is proved by the fact that with this glass the eye has the standard acuteness of vision; when $-1 D$ is put up in addition, it makes these parallel rays divergent. To focus these on the retina the eye must increase its refractive power to the extent of $1 D$, and this it does by unconsciously calling A. into play to that extent.

If we were to put up $-11 D$ in the trial frame we should still probably get $v = \frac{6}{6}$; in this case $3 D$ of A. would be in action, neutralising the excess of $3 D$ in the concave glass. In fact, a concave glass correcting the *apparent* M. of an eye may be supposed to be made up of two parts, one of which corrects the *real* M., the other of which neutralises the amount of A. called into play. The former part is a fixed amount; the latter varies and equals the excess of strength of the glass. We cause the latter to disappear by making the excess of strength of the glass to disappear—i.e. by finding the *weakest* glass, which gives the best attainable distant vision.

To resume: the measure of M. is the weakest concave glass which gives the best attainable distant vision.

This is the most convenient test of M.; but there are others to be applied with the ophthalmoscope, which must be briefly noticed.

In looking into a myopic eye with the ophthalmoscope, the mirror being held at a considerable distance from the observed eye, an inverted image of the fundus is seen. This is formed in the air in front of the eye at its *punctum remotum*. To see it, the surgeon must be farther off the patient than this *punctum remotum*. When the observer, still having the fundus image in view, makes slight lateral movements of his head, the image moves in the opposite direction. As he approaches the patient's eye, this image gets blurred, and then disappears; when he gets the ophthalmoscope into the ordinary position for direct examination, no distinct view of the fundus is obtained unless a concave glass is used behind the mirror. The *weakest concave* glass which gives a distinct view of the fundus in this position equals the amount of M. See OPHTHALMOSCOPY.

This is only the case, however, if the eye of the surgeon be in a state of emmetropia at the moment the examination is made. If he be myopic, the amount of his M. must be *deducted* from the concave glass, in order to get the amount of the patient's M. If he be hypermetropic, and have his A. relaxed, the amount of the H. must be *added*.

In retinoscopy the shadow moves with the mirror, unless M. be of very low degree—say less than 1.50 D.

Complications.—These attend the higher grades. The most common is what is called a 'posterior staphyloma;' this is, anatomically, a bulging of the coats of the eye in the neighbourhood of the optic disc; the pathogeny of it is uncertain. It may be well marked, so as in the enucleated eye to be easily recognisable as an ovoid protuberance. It is accompanied by atrophy and irregular pigmentation of the surrounding retina. With the ophthalmoscope, it is generally seen as a crescentic patch of atrophy extending along the outer margin of the disc; as it extends it embraces still more of the disc, and may reach outwards to the macula; or further, assuming then the most irregular forms. It lengthens still more the already elongated eye, and so increases the M. when it extends to the macula, that it seriously impairs v. This patch of atrophy is known as the 'myopic crescent.'

Other complications are fluidity of the vitreous with floating opacities, detachment of the retina, and divergent strabismus.

The latter is a much rarer attendant of M. then convergent strabismus is of H.

Treatment.—Much may be done in the way of preventive treatment by securing good school arrangements, proper lighting, well-constructed desks, &c.

When M. is already developed, what may be called the hygiene of the eye should be carefully attended to. Myopic children should not be subject to educational over-pressure, should not use their eyes up to the point of making them ache; if there be much irritation or fatigue about the eyes, prolonged absence from school should be insisted upon. It is right that M. should be taken into account when the time comes for the choice of a profession.

In all cases we must prescribe well-printed books and good illumination of them. The most comfortable artificial light is a good oil lamp, well-shaded, so that no direct light falls on the reader's eyes; in writing, the lamp should be placed on the writer's left front, so that the shadow of the pen may not interfere with the view. Books or writing must be held at a good distance, and stooping avoided. Frequent rest must be given to the eyes, and if they are irritable the cold douche may be used.

The optical treatment of M. is quite easy in the *low grades*, say up to 4 D. Here, all the patient complains of is that distant vision is imperfect; he can see to read and work quite well, his far point lying beyond the distance at which this can be done with comfort. Here, the glasses that fully correct M. may be ordered.

As these are intended only for distant vision, and therefore for occasional use, they may be worn in a frame or a *pince-nez*, as the patient chooses.

They are to be worn solely as a matter of convenience, and not as being at all necessary to the well-being of the eyes. Patients often want glasses especially for music. Pianoforte music lies usually at about 20" from the eye; if M. be not greater than 2 D, the far point of the eye being in that case not less than 20", no glasses are wanted; if M. be greater than 2 D, glasses will be necessary, and the full correction may be worn.

In M. of medium grade, say 4 D up to 8 D, as a rule glasses will be wanted both for distance and for reading; the distance glasses are a matter of convenience, as in

the lower grades of the affection. But reading glasses *must* be worn; without them, the strain on the eyes caused by the excessive convergence of the visual axes necessary for reading will certainly increase M., besides giving rise to much immediate trouble, aching of the eyes, and the other discomforts that have been already spoken of as attending the higher degrees of M. The distance glasses will be the full correction as before, and if the patient be young, and A. therefore good, the same glasses may do for reading. In these cases, however, A. has so long been in abeyance prior to the use of glasses, that it cannot be expected to be so active as in an emmetrope. As a rule, however, we may at first order that the distance glasses should be used for reading also; if no discomfort ensues, they may be continued in use; if, however, they cause pain, a somewhat weaker pair must be ordered for close work. For instance, suppose a patient with $M. = 8\text{ D}$; here $R = \frac{100}{8}$

cm. (4 inches). There is no distinct vision beyond 4 inches, and, further, vision at that distance is probably irksome on account of the excessive convergence necessary to bring both visual axes to bear on the same point.

Here 8 D should be ordered for distance, and in suitable cases also, tentatively, for reading and working. As 8 D brings the eye into the condition of an emmetropic one, the amount of A. necessary for reading

at 25 cm. ($10''$) will be $\frac{100}{25} = 4\text{ D}$. Now it is found by experience that, for continuous work, only about one-half of the full amount of A. at the disposal of an eye can be comfortably exerted. The ciliary muscle is in this respect like other muscles; it cannot exercise its full power for a long period without fatigue. The eye we are considering ought then to have 8 D of A. at its disposal, in order to read comfortably with the glasses; the table above given will show whether the patient's age is such that this amount of A. may be expected. Something also must be allowed for the fact of the eye being a myopic eye, and therefore not in the habit of using its A.

Say the patient's age is twenty. The table shows that at twenty the eye has 10 D of A.

This eye, then, will have the necessary amount of A. (8 D) for continuous reading, and still a reserve of 2 D . This may be called, then, a suitable case for ordering, experimentally, the full correction for both

distant and near use. If after a week or two's trial the glasses cause pain, a weaker pair may be ordered for reading; the deduction commonly made is 2 D , so that we should now prescribe -6 D for reading, the full 8 D being still used for distance. In wearing -6 D for reading at 25 cm. ($10''$) what demand is made on A.? We have seen that with the full correction -8 D , 4 D of A. is wanted; with -6 D , only 2 D of A. will be required. The eye ought then to have a total A. $= 4\text{ D}$, or rather more as it is a myopic one, say 5 D . Now, the table shows that A. does not reach so low a stage as 5 D till the age of 40 is approached. Hence, up to this age the glasses above suggested may be expected to suit the patient. Or, it may be advisable to order the glasses in a different way; if the patient's occupation be principally about things that lie near him, the weaker glasses may be used pretty constantly, and when very distinct distant vision is wanted, additional glasses that represent the difference between these weaker glasses and the full correction (in the above case -2 D) may be held up in a *pince-nez* before the other glasses in a frame.

The same rules apply to the higher grades of M. above 8 D . They must, however, be taken as only suggesting the principles to be followed. In no other affections of the eye is it more necessary to treat each case on its own merits.

It is principally in these high grades of M., but to some extent in the medium grades also, that all the discomforts described above are found. V is here nearly always much impaired, on account of changes in the fundus; the glasses necessary to remove the far point to a safe distance diminish the retinal images, and still further impair V. The patient is then tempted to hold his work near again, and then all the evil results of excessive convergence again ensue. If the struggle for binocular vision is given up, and one eye remains in a condition of divergent squint, the patient is often in a better condition. The diverging eye, it is true, suffers and may become amblyopic, but the other one is more comfortable. In addition to the best optical aid that can be given, all the hygienic measures recommended as general treatment should be put into force; if M. be rapidly increasing, and the symptoms of irritation severe, complete rest must be insisted upon, and the eye well protected from light; further treatment might consist in the use of flying blisters on the temples, or even occasional wet cupping with Heurte-loup's artificial leech.

(b) **HYPERMETROPIA.**—Here parallel rays come to a focus behind the retina. This is due to a disturbance of the normal relation that exists between the length of the eye and its refractive power. Actually, it is generally the case that the axis of the eye is too short; we shall, however, consider it as being due to a *decrease* in the refractive power of the eye, just as we considered M. to be due to an *increase* in this power. We may imagine that in H. we have an emmetropic eye armed with a concave lens in front of it. The strength of this lens will be a fair measure of H., since it represents the departure from the emmetropic eye.

Let us examine the peculiarities of vision in H., and suppose, for example, we have an eye with H. = 6 D.

This is equivalent to an emmetropic eye with a lens -6 D in front of it. Now this lens will make parallel rays to proceed as if they diverged from its principal focus—i.e. from a distance $\frac{100}{6}$ cm. in front of it.

These rays falling on the emmetropic eye, which we have imagined combined with the concave lens to form the hypermetropic eye, will not be focussed on its retina; only an emmetropic eye can focus parallel rays on its retina while the accommodation is at rest. Hence, distant objects, from which such parallel rays emerge, will not be seen distinctly by the hypermetropic eye. Still less will near objects be seen distinctly. The only rays that can be focussed on the retina in this case are rays which are parallel after having passed the hypothetical concave lens, and which therefore are converging virtually to its principal focus—i.e. to a point $\frac{100}{6}$ cm.

behind it. But the rays which proceed from all objects are divergent rays; hence, the hypermetropic eye, being able to focus on its retina only convergent rays, cannot (unassisted) see any external object distinctly. This is only so long as it remains at rest. When it calls into action its accommodative power, which, as we have seen, is equivalent to placing a convex lens in front of it, it can not only neutralise the hypothetical concave lens which represents its H., and so see distant objects distinctly, but, by a further tension of A., it can adapt itself for divergent rays, and so see near objects plainly. Suppose the above eye, for instance, in which H. = 6 D belongs to an individual ten years old. At ten our table shows that the total A. = 14 D. By exerting 6 D of his A., then, this person neutralises his

H., and brings his eye into the position of an emmetropic one, and has still 8 D of A. in reserve.

In this condition he sees distant objects distinctly. If he wishes to see near objects, he makes a further demand on his A., the amount depending on the distance of the object. Suppose the object is at 25 cm.

(10') from the eye: a convex lens of $\frac{100}{25} = 4$ D

at the eye would make rays diverging from the object parallel, and therefore in a condition to be focussed on the retina of the eye, which by using 6 D of its A. is already in a condition of emmetropia; the additional call upon A. then = 4 D, and the total amount of A. required by this hypermetropic eye for seeing distinctly at 25 cm. is 10 D. Will this eye be able to work for long at this distance? No; we have seen above that, for continuous work, not more than half A. must be in use; here 10 D—the whole of A. being 14 D—is in use. The eye, then, if called upon to work for long at this distance, would tire. An emmetropic eye, on the contrary, at the same age, having 14 D at its disposal, and not requiring to use any of this to correct any H., would want only 4 D out of the 14 for working at this distance, and would therefore do it easily. This fatigue of the eye on working is the type of the complaints of the hypermetrope.

Etiology, &c.—H. is always congenital, and never increases in after-life except slightly in old age; it may diminish, and even change into M., owing to elongation of the eye. After removal of the lens in the operation for cataract, a high grade of H. is produced owing to loss of refractive power: this is called aphakia. The amount of H. varies within wide limits; 2 or 3 D is a very common amount; 8 D would be thought a highest degree; in aphakia in an originally emmetropic eye H. equals about 10 D. The amount of H. in the two eyes is usually nearly the same.

Symptoms.—In low degrees there are often no symptoms till the patient approaches middle life; then, several years before people usually want spectacles, he comes with the usual complaints of presbyopia; cannot see to read, especially by artificial light, &c.

The age at which these symptoms occur depends on the amount of H. and the distance from the eye of the habitual work. At the age of thirty, for instance, total A. = 7 D, and therefore 3.5 D can be exerted continuously.

Now, for continuous work at 40 cm. (16") an emmetropic eye requires $\frac{100}{40} = 2.50$ D

of A. Suppose the person of thirty years of age has 1 D of H., then 1 D of his 3.5 of available A. will be used up in correcting the H., and the remainder 2.5 D will just suffice for continuous work at 16". Such a person would in a year or two probably need spectacles for his usual work.

In the higher degrees, even young people suffer much. Often the break-down of the general health determines the onset of the symptoms. In very high degrees M. may be simulated: distinct images being in no way attainable, objects are held very close so as to get large retinal images, and hence the patient is supposed to be short-sighted. In old people who have never worn glasses, and have a considerable amount of H., vision for near and distant objects may be so defective that the surgeon may, if he neglect to try the effect of convex glasses, diagnose some serious nerve-affection.

Diagnosis and Measurement.—The complaints of the patient usually indicate pretty clearly what is the matter. His 'eyes are weak'; close work soon tires him; the letters run into one another, get dim, &c.

We now proceed to test v in the usual manner, trying each eye separately, and both with near types and distant.

If v for distant objects be improved, or even not made worse by a convex lens, it is a case of H.

The amount of H. is given by the *strongest convex* lens which gives the best attainable vision at 6 mètres. It must be the *strongest* convex lens, in order to secure the complete relaxation of the accommodative power. Contrast this with the rule for M.; there it was the *weakest concave* lens which gave the best attainable vision at 6 mètres. A short consideration analogous to the one set out in the case of M. will show the reason of the rule in H.

There is, however, a difference in the case of H. Here, as we have seen, some amount of A. is always in play, even for distant vision, and a considerably larger quantity for near vision. The result of this is that the ciliary muscle gets into a condition of spasm, and will not relax when its continued contraction is no longer wanted, nay even is injurious to distinct vision.

Suppose $H. = 4$ D, and that glasses have never been worn; here 4 D of A. has always been in use for distant vision, and 7 D or 8 D

for near vision. In testing the eye now with the types at 6 mètres, probably $v = \frac{6}{6}$ without any lens at all, the 4 D of A.

being in action; 1 D is put up in the trial frame; as the eye will bear only +4 D in front of it for distant vision, 1 D of A. must

be relaxed if v is to remain $= \frac{6}{6}$. Suppose

v remains unimpaired, +2 D is now put up in the trial frame; if v is now to remain $= \frac{6}{6}$, another 1 D of A. must be relaxed.

If now the ciliary muscle be in the condition of spasm, it may refuse to relax this additional 1 D, even though strongly solicited to do so by the desire of the eye for distinct vision. If it do not so relax, 1 D would be the strongest convex glass that gave the best attainable vision at 6 mètres, and so 1 D would appear to be the amount of H., whereas H. is really = 4 D. In such a case as this, the total amount of H. would probably only appear when atropine or some such agent was used to thoroughly relax the ciliary muscle. The total amount of H. revealed after the prolonged use of atropine is called H. totalis (H. t.); the amount of H. that reveals itself when convex glasses and no atropine are used is called H. manifesta (H. m.); the difference between the two is called H. latens (H. l.). A small amount of H. l. is always present; it is only when it exceeds 2 D or 3 D that this formal distinction between H. t. and H. m. is made. When H. is written unqualified, H. m. is meant.

Ophthalmoscopic Tests.—In looking into a hypermetropic eye with the ophthalmoscope, at a considerable distance from the observed eye, a real image of the fundus is seen. This does not disappear as the patient is approached. When slight lateral movements of the surgeon's head are made, the image of the fundus moves in the *same* direction. When the surgeon gets the ophthalmoscope into the ordinary position for direct examination, the image is still plainly seen, and continues clear when convex glasses are used behind the mirror. The strongest convex glass with which the fundus can be distinctly seen is a measure of the H. (if the surgeon be himself emmetropic).

In retinoscopy the shadow moves against the mirror. It does so also in low M.

Complications.—The only one that need be mentioned is concomitant squint, which is nearly always convergent. See STRABISMUS.

Treatment.—This is simple and very successful. In ordinary cases it is enough to give glasses that neutralise the H.m.

If after a time there should be pain with these, the existence of a considerable amount of H.l. should be suspected. To get at once to the bottom of the case, atropine should now be ordered, and H.t. found. If this differ much from the H.m. originally found, fresh glasses should be ordered. These should be about 1 D weaker than the full correction, to allow for the inevitable slight spasm of accommodation, which will come on as the effect of the atropine wears off.

These glasses need generally be worn only for close work.

In high grades of H. it is best to give the full correction, and order the glasses to be worn constantly. This is especially desirable in children.

In the case of old people, two pairs will be wanted—one for distant vision and one for near work; or even intermediate pairs may be needed, if distinct vision is desired at intermediate distances.

It will be useful here to contrast the diagnosis of M. and H.

In M. distant v is *improved* by a $-v^e$ glass.

In H. distant v is *not made worse* by a $+v^x$ glass.

In M. the retinal vessels move *against* the observer.

In H. the retinal vessels move *with* the observer.

In M. the retinoscopic shadow moves *with* the observer (generally).

In H. the retinoscopic shadow moves *against* the observer.

The amount of M. is the *weakest concave* glass which gives the best attainable distant vision.

The amount of H. is the *strongest convex* glass which gives the best attainable distant vision.

The amount of M. is the *weakest concave* glass with which the fundus can be distinctly seen by the direct method.

The amount of H. is the *strongest convex* glass with which the fundus can be distinctly seen by the direct method.

A few cases are here given to illustrate the method of testing and noting the vision:—

Case 1.—Low M. The patient, a woman, thirty years of age, complains of being near-sighted. On testing the eyes it is found

$$\text{R. E. } v < \frac{6}{60}; \text{ with } -3 \text{ D} = \frac{6}{9};$$

no improvement with cylinders.

J. i. at 30 cm.

$$\text{L. E. } v < \frac{6}{60}; \text{ with } -3.30 \text{ D} = \frac{6}{9};$$

no improvement with cylinders.

J. i. at 30 cm.

Here -3 D was ordered in a *pince-nez* for distant vision; the eyes being used unaided for reading.

Case 2.—High M. The patient, a carpenter, aged thirty-four, complains of not being able to see his work. Examination reveals—

$$\text{R. E. } v < \frac{6}{60}; \text{ with } -9 \text{ D} = \frac{6}{18}.$$

J. i. at 12 cm.

$$\text{L. E. } v < \frac{6}{60}; \text{ with } -9 \text{ D} = \frac{6}{12}.$$

J. i. at 12 cm.

On trial it was found that with -7 D he could read J. i. at a fair distance, and the same glasses gave $v = \frac{6}{24}$. As he was

satisfied with this amount of distant vision, he was ordered only one pair of glasses, -7 D for constant use.

The above form of noting the result of the visual examination will be found a convenient one. Where v at 6 metres does not come up to $\frac{6}{60}$, the patient might be

brought up to the types till he could see the largest—viz. 60, if an exact numerical expression were desired for v ; in most cases it is enough to note that v is less than $\frac{6}{60}$; this is commonly written $v < \frac{6}{60}$.

Case 3.—Low H. Patient, a woman of twenty, complains that she cannot see to work at night.

$$\text{Here R. E. } v = \frac{6}{6}; \text{ with } +2 \text{ D, } v \text{ still} = \frac{6}{6};$$

therefore H. = 2 D.

J. i. 8"—12" (8" the near point, 12" the far point).

$$\text{L. E. } v = \frac{6}{6}; \text{ H.} = 2.50 \text{ D.}$$

J. i. 8"—12".

In this case $+2.50$ worn for work gave complete relief.

Case 4.—High H. The patient, a girl of twelve, was brought with the complaint that she was *short-sighted*. It was found, however, on examination, that it was one of the cases of H. simulating M.; in fact, after atropine, it was found—

R. E. $H = 9 D$; and with $+9 D$, $v = \frac{6}{18}$.

L. E. $= 10 D$; with $+10 D$, $v = \frac{6}{18}$.

She was ordered $+8 D$ for both eyes, an allowance of $1 D$ being then made for the effect of the atropine; these were to be worn constantly. After a few months with the glasses,

R. E. $v = \frac{6}{9}$; L. E. $v = \frac{6}{18}$.

The refracting surface of the eye has hitherto been supposed spherical, so that the image of external point on the retina was either a point or a circle of diffusion; there are, however, many eyes in which the surface is not spherical, so that different meridians of this surface have different curvatures.

This condition of the eye is called **ASTIGMATISM**. It is divided into regular and irregular.

The *irregular* is generally due to some disease of the cornea, which has so distorted it that it is no longer any definite mathematical surface at all. It is seldom susceptible of any optical help, and will not be further alluded to here.

In *regular astigmatism* the surface is formed according to definite laws. There is one meridian of greatest curvature; another, at right angles to the first, of least curvature; and the intermediate ones are of intermediate curvature. These meridians are all nearly circular. The meridian of greatest curvature is generally vertical. To save space, it will, in what follows, be supposed that it is always so, and, consequently, that the meridian of least curvature is horizontal. In considering the refraction of rays by an astigmatic surface, we find that the image of an external point is a short horizontal *line* at the conjugate (to the external point) focus of the vertical meridian, and in the neighbourhood of this focus the image is a horizontal *oval*; at the conjugate (to the external point) focus of the horizontal meridian, the image is a short vertical straight line, and in the neighbourhood of this focus a vertical oval; midway between these two foci the image is a circle.

Now, suppose we have a straight line external to the eye; call this AB , and first suppose it to be vertical. Further, let us call the focus of the vertical meridian F_v ; that of the horizontal meridian F_h ; this line may be supposed made up of a series of points, arranged vertically over one another.

At F_v the image of each of these points is a short horizontal straight line, and therefore the image of AB a series of horizontal straight lines, parallel to one another and placed side by side; the image of AB is then a faint, wide vertical stripe.

At F_h , on the contrary, the image of each point of AB is a short vertical straight line, and therefore the image of this external vertical straight line a series of short vertical straight lines which overlap one another; this image, then, is a thin, well-defined vertical line. Now, suppose AB a little inclined to the vertical. Each point of it will, as before, have a short horizontal straight line for image at F_v ; but these lines do not now lie directly over one another, but are arranged like the steps of a steep staircase, and they overlap one another a little; the image of AB at F_v is then a stripe parallel to it, and rather more defined than when it was vertical.

At F_h the series of short vertical straight lines, which are the images of the points of AB , overlap, but not so directly as they did when AB was vertical: the image of AB at F_h is then a stripe parallel to it, and rather less defined than when it was vertical.

Hence, if AB in its new position slightly incline to the vertical, at neither F_v nor F_h is a clear image formed; still less is the image clear at intermediate points between F_v and F_h , where the image is formed by a series of overlapping, horizontal, or vertical ovals, instead of horizontal or vertical straight lines, as at F_v or F_h .

As AB departs more and more from the vertical its image at F_v becomes more distinct, its image at F_h less distinct; until it becomes horizontal, when at F_v there is a perfectly distinct image formed, whilst at F_h the image is very indistinct.

Hence, when the two chief meridians of the eye are vertical and horizontal, of only two external straight lines are clear images formed, and these are the vertical, of which a clear image is formed at F_h , and the horizontal, of which a clear image is formed at F_v . If we now suppose the retina of the eye situated at F_h , only vertical lines will be seen quite distinctly: other lines will be seen with increasing indistinctness the more they depart from verticality, and horizontal lines will be the most indistinct of all.

If the retina be at F_v , just the reverse of this will be the case—i.e. horizontal lines only will be seen distinctly, others with varying indistinctness; whilst if the retina

be situated neither at F_h nor F_v , no lines will be seen distinctly.

Now, the human eye has the power, by means of its accommodation, of making the position of the retina coincide with either F_v or F_h , or occupy intermediate positions. Hence, generally an astigmatic eye can see distinctly lines parallel to its two chief meridians; not simultaneously, however, but by two different efforts of its accommodative power. But it has no power of seeing distinctly lines in other directions. As the contours of objects are made up generally of lines running in an infinite number of directions, it is easily imagined how indistinctly such objects are seen by an astigmatic eye.

At any given moment, the eye sees distinctly only the outlines of an object parallel to a certain line; by an effort of its ciliary muscle it can so alter its refractive power as to see the outlines running in a direction perpendicular to the first. Probably, an astigmatic eye is thus continually altering its accommodative tension, so as to get clear outlines in two directions of each object that is successively presented to it. This continual change of strain of the ciliary muscle accounts for much of the fatigue from which such eyes suffer.

Regular astigmatism is divided into five varieties; (1) if, A. being relaxed, both chief meridians are myopic—it is called compound myopic astigmatism; (2) if one meridian be myopic, the other emmetropic—it is called simple myopic astigmatism; (3) if one meridian be emmetropic, the other hypermetropic—it is called simple hypermetropic astigmatism; (4) if both meridians be hypermetropic—it is called compound hypermetropic astigmatism; and (5) if one meridian be hypermetropic and the other myopic—it is called mixed astigmatism.

Etiology.—Regular astigmatism is nearly always congenital. After operations on the cornea, however, a considerable amount of regular astigmatism is often seen. It is generally nearly equal in amount and symmetrical in the two eyes. High degrees of M. or H. are nearly always complicated with astigmatism. It often runs in families.

Cylindrical Lenses.—The difference in curvature between the two chief meridians may be corrected by a cylindrical glass. This has no curvature—is plane parallel to its long axis; in the meridian perpendicular to this may be ground to any curvature; whilst the intermediate meridians have intermediate curvatures. The correction of the accompanying M. or H. is of

course made by a spherical glass, on which the cylinder can be ground. Generally, the sphere is given which corrects the meridian of greatest curvature in H., or least curvature in M.; this accordingly must be combined with a negative cylinder, strong enough to correct the other meridian. A cylindrical lens has no refractive effect in a meridian parallel to its axis, and this accordingly in the correcting glass, if a negative cylinder be used, must be placed parallel to the meridian of greatest curvature in H. or of least curvature in M. Suppose, for example, in vertical meridian M. = 6 D, in horizontal meridian M. = 4 D; then a $-ve$ sphere = 4 D would be given, combined with a $-ve$ cylinder = 2 D, with its axis horizontal.

It would come to the same thing if a $-$ sphere = 6 D and a $+ve$ cylinder = 2 D, with its axis vertical were given.

Diagnosis and Measurement.—The complaint is generally of 'weakness of the eyes,' so that at first we do not know that it is not a case of simple M. or H. When, however, with the best spherical glass v is

considerably below the standard $\frac{6}{6}$, astig-

matism may be suspected. This is especially so in the case of H., where degenerative changes in the fundus are relatively rare. The diagnosis can often be made with great certainty by holding up in front of the eye, already armed with the sphere (+ or -) that gives the best v at 20', a weak $-ve$ cylinder, say, -1 D cyl.

If this be held with its axis parallel to the meridian of least curvature, it will almost certainly improve v. Now this meridian of least curvature is, in most cases, horizontal or nearly so.

We hold this weak cylinder, then, with its axis horizontal, and see if v is improved thereby; if not, we slowly rotate it in front of the eye through a complete half-circle, asking the patient if there is any improvement of v in any position. If not, there is no astigmatism. If there is, the position of the axis that gives the best v is the meridian of least curvature of the eye, and the other chief meridian is of course perpendicular to this. We then hold up stronger $-ve$ cylinders with axis in the same position. The weakest cylinder that gives the best attainable v is the measure of the astigmatism.

In this way many cases can be quickly tested both qualitatively and quantitatively.

There are many other tests for astigmatism, both subjective—i.e. depending on

the answers of the patient like the above, and objective. Of the objective the only one we shall refer to here is RETINOSCOPY. A complete discussion of this method will be found under this heading.

In many cases of astigmatism, a satisfactory result cannot be got without using a mydriatic. This may be either atropine, of which a solution gr. ij. ad f3j. may be used three times a day for three or four days; or homatropine, a solution of the same strength for three or four times. The atropine completely paralyses the ciliary muscle, and so makes near vision (except in certain grades of M.) very dim. This effect passes off in about a week or ten days. The homatropine does not suspend the accommodation so completely as atropine; but the effect passes off much more completely than that of the other drug; generally, accommodative power is fully restored in twenty-four hours. It may be used as a substitute for atropine, when the patient cannot submit to the week's dimness of sight the latter generally causes.

The vision is to be tested whilst the eyes are fully under the influence of the drug; an interval is then to be allowed for them to recover (say ten days for atropine, two days for homatropine), and then the glasses ordered which give the best v in this condition. These will generally be found to differ from the best glasses under atropine in being about 1 D weaker, this being the usual amount of the tonic spasm of A. before referred to. If there be a great difference between the refraction with and without atropine, glasses 1 D weaker than those giving the best v under atropine should be given for constant use as soon as the atropine is discontinued. It may be asked, why use atropine at all, if glasses are to be finally ordered adapted to the non-atropinised state? The answer is, partly to provide for these cases of excessive spasm, partly to facilitate the objective examination.

In any case where strong glasses are ordered, either spherical or sphero-cylindrical, the patient must expect a few weeks' discomfort till the eyes get accustomed to working under the new conditions. They should be worn continuously and perseveringly. Children adapt themselves much more readily than adults to such glasses.

A case of astigmatism is subjoined:—

Case 5.—As. The patient, an architect, aged twenty-two, suffers from headache all day. This he attributes to wearing impro-

per glasses. These he has used constantly for the last twelve months; they are R.E. — 6.50 D, L.E. — 5.50 D. Tested R.E. $v < \frac{6}{60}$; with — 7 D sph. \bigcirc — 3 D cyl., axis 80° up and in from vert. $= \frac{6}{9}$. L.E. $v < \frac{6}{60}$; with — 5 D sph. \bigcirc — 2 D cyl., axis 80° up and in from the vertical $= \frac{6}{9}$.

He was ordered these for constant use, and had no further trouble. The symbol used above after sph. (spherical) denotes 'combined with.' The direction of the axis may be indicated as above, or, better still, by a diagram.

Another error of refraction must be referred to. This is ANISOMETROPIA. This term is applied where there is a considerable difference between the refraction of the two eyes. Small differences are common enough in M. and As.; it is only when the difference reaches say 2 or 3 D that anisometropia is spoken of. It is often very difficult to treat if the difference be considerable. In slight cases each eye may be fully corrected, or else the correction adapted to the less ametropic of the two ordered. Sometimes the medium correction answers best; but each case must be treated on its own merits. Occasionally, where one is M., the other Em. or H., the former is habitually used for near work, the latter for distance, and no discomfort felt.

It remains to speak of *spectacles*. The fitting of these may generally be left to the optician; but the surgeon should satisfy himself that the glasses have their centres opposite the patient's pupils, unless it is otherwise desired, and that they are of the strength ordered. To test any given lens, a test glass of its alleged focal power but of opposite denomination—i.e. $+^v$ or $-^v$, according as the lens to be examined is $-^v$ or $+^v$, is held in contact with it, and the two held close to the surgeon's eye and moved rapidly from side to side. If the test glass now exactly neutralise the other, any distant object—say the window-bars—seen through the combined glass remains stationary. If the combination is $+^v$, it moves in the opposite direction, if $-^v$ in the same direction.

Patients often ask if they should have pebbles. These have no optical advantage over crown glass, and are much more expensive. Sometimes reading glasses require to be tilted forward at an angle of 10° or 15° —'angled,' as it is called. This is to be indicated in the prescription. The form a

prescription commonly takes is the following:—

[Patient's name.]

Glasses for reading:

+ 8 D

[Surgeon's name.]

or, in more complicated cases—

[Patient's name.]

Glasses for constant use:

Right eye: + 2 D sph. \bigcirc - 4 D cyl., axis 80°
from vertical up and out.

Left eye: + 2 D sph. \bigcirc - 3.50 D cyl.,
axis 20° from vertical up and out.

[Surgeon's name.]

If any particular form of frame or colour of glass, such as neutral tint, be required, proper directions will have to be added to above. W. CHARNLEY.

REGNOL'S OPERATION. *See* TONGUE, Operations for Removal of the.

RENAL CALCULUS. *See* NEPHROLITHIASIS.

RENAL COLIC is a term employed to describe a train of symptoms, due to the sudden stoppage of the ureter by some foreign body passing down its lumen, or to some morbid condition of its own walls. The onset is nearly always sudden, the most prominent symptom being pain, usually of a very severe kind, due, on the one hand, to the great sensibility of the ureter, and, on the other, to its own efforts to dislodge the intruding mass by virtue of its involuntary vermicular action. The duration of this pain is determined, first, by the accumulation of fluid behind the obstruction, and by the size and shape of the foreign body, and then by the strength of the muscle-fibres of the ureter. Fortunately, it does not usually last long, the mass either being forced onwards into the bladder, or the ureter becoming more or less accustomed to its presence. The causes of obstruction of the ureter, and consequent renal colic, may be the passage of—(1) a calculus, (2) a blood-clot, (3) a caseous shred of tubercular matter, (4) hydatids, (5) a portion of new growth, (6) the presence of a tubercular ulcer in the tube.

The *symptoms* in an ordinary attack are, usually, as follows. An agonising sickening pain sets in, usually with great suddenness, in the renal region, and radiates from this down the track of the ureter into the genitals and inner part of the thigh. With this there is often faintness and even vomiting, the patient probably at the same time breaking out into a cold sweat all over the body. When the first faintness has passed off,

he will probably bend and twist the body nearly double with suffering, and endeavour to relieve himself by contortions in all directions. There will also be, in the male, most likely a retraction of the testicle. In some cases, the temperature is raised, and the pulse becomes rapid and feeble. Then, after a period, usually measured by hours, there is a complete cessation of the pain, as sudden as its onset, and a disappearance of the other troubles as well.

The *diagnosis* is based, first, upon the previous history of the case—i.e. if the patient has passed small calculi or 'gravel' before, or has had attacks of hæmaturia, or evidence of tubercular disease, parasites, or new growth in the kidney. Again, if there has been hæmaturia and the ureter is stopped by blood-clot, the water, previously blood-stained, will be passed clear during the colic, to return to its former red colour with the cessation of the pain, at the same time that small, worm-like clots are passed with the urine *per urethram*. In the same way a small calculus may be passed.

The paroxysms of pain, with which renal colic is most likely to be confounded, are (1) ordinary colic, (2) the passage of biliary calculi, (3) sudden obstruction of the urethra by blood-clots, stone, or new growths. From the first of these it will be distinguished by the seat of the pain and suddenness of the onset, usually after some renal symptom; by the absence of constipation, and then by percussion, which will probably indicate the condition of the intestine. Palpation, too, will often detect the painful spot in the flank where the obstruction of the ureter has taken place, and may even make out the foreign body. From biliary colic a distinction is made by means of the history, the seat of the pain, and in some cases by the occurrence of jaundice. Blood-clots, stone, and new growths in the bladder, leading to sudden obstruction of the urethra, can be demonstrated by the introduction of a catheter or sound, as well as diagnosed from the clinical history.

The *treatment* of renal colic varies with the cause, and resolves itself into palliative and curative. Under the first head will come, rest in the recumbent position, hot belladonna fomentations over the whole side, and the repeated injection of morphia in free doses hypodermically. In the case of blood-clots, calculi, or tissue-shreds, free kneading and manipulation over the track of the ureter, in the hope of assisting the passage of the foreign body into the bladder, may be tried. *See* NEPHROLITHIASIS; NEPHROLITHOTOMY. ARTHUR E. BARKER.

REST.—‘The first and great requisite for the restoration of injured parts is rest,’ was John Hunter’s epoch-making generalisation. Than that, no proposition is more worthy of the surgeon’s thought, none more fertile for his patient’s good. The principle of constitutional and local rest is so interwoven with the whole teaching of this work, that it would be impossible to do it separate justice without time-wasting recapitulation. Yet, as one of those fundamental truths which cannot be inculcated too often or too impressively, an endeavour to methodise some of the most conspicuous advantages of rest may be justified by practical convenience and usefulness.

As movement increases the heart’s action and is opposed to blood-coagulation, so this is favoured, and that retarded, by rest. Hence the value of rest in the treatment of disease and injuries of the blood-vessels, in wounds and aneurisms.

To quote from Mr. Hilton’s classical lectures on ‘Rest and Pain,’ ‘growth and repair have an exact relation to due physiological rest, local and general.’ Accordingly, the repair of solutions of continuity in all tissues, hard and soft, proceeds in closest conformity to the physiological standard and with the minimum risk of pathological complication, the more perfectly divided parts, once re-adjusted, are maintained in a state of absolute repose. On this principle is based the sound practice of infrequent wound-dressing, and of treating broken bones and acute articular affections by immobilising the joints above and below, as well as the seat of mischief.

Mechanical and physiological, constitutional and local, medicinal and manual resources, such as darkness and mental quiet, anæsthetics, opium and allied preparations, position and suspension, cold and pressure, are all, in appropriate proportion, powerfully contributory to rest and repair. Once more experience teaches the great lesson, that complexity in the causation of pathological states necessitates combination of therapeutic resources for purposes of relief and cure.

Rest is something more than a mere negation of motion, as illustrated by the apparently, but not really, simple case of an irritable ulcer on the swollen leg of a big-bellied person. In such a patient, rest in the recumbent posture, and suspension of the foot soon give temporary ease; but recovery is greatly favoured by elastic pressure of the limb, and by administering a brisk purge, which may often be advantageously followed up with opiates. The

constitutional and local rest combine in relieving vascular and nerve tension, and favouring healthy nutrition. In anal fissure and fistula, healing is prevented by the contractility of the very sensitive and active sphincter muscle. Divide as much of it as is necessary to insure rest in the particular case, and healing proceeds painlessly and solidly. The pain occasioned by foreign bodies, such as a thorn in the finger, a fish-bone in the throat, or a stone in the bladder, or by a dislocated or broken bone, ceases with the removal of the cause of unrest, be it extraction of the foreign body or restoration of the displaced part to its normal relations. So with the vomiting and pain due to strangulated hernia. Injuries of the chest and abdomen supply further illustrations in point. In such cases rest in the recumbent posture affords great, but not complete, relief. Where several ribs are broken, with or without wound of the soft parts, the chest requires good padding and abundant bandaging with equable pressure. A lattice-work of millboard, or other mouldable splintage, contributes powerfully to comfort; and so does fixing the arm, to rest the pectoral and dorsal muscles completely, on the injured side. Opium is additionally useful; the medicinal and mechanical treatment combining to reduce the number of respirations, and to favour abdominal breathing, during fixity, rest, and repair of the chest-wall. When the abdomen is bruised or wounded, rest is promoted by sedatives, by resting on the back with the shoulders raised and the thighs flexed, equable pressure being at the same time applied over the abdominal wall. Such pressure may be very beneficially practised, according to the requirements of particular cases, by broad bandages over good padding; or by means of a heavy poultice, or a shot mattress; a sand, water, or ice bag.

In painful cases of retention of urine, when ineffectual attempts have been made to pass a catheter, an anæsthetic may render easy what was before impossible. That failing, opium pushed judiciously to its full action, as indicated by contraction of the pupils, often succeeds in lulling pain, relaxing spasm and congestion, and allowing the urine to dribble, and, by-and-by, to flow. When, in such a case, anæsthetics, the catheter, hot hip-bath, purgatives, and opium all fail, and the bladder can only be saved from threatened rupture by suprapubic aspiration or tapping *per rectum*, urine often flows with comparative freedom *per urethram* once engorgement and spasm of

the passage are relieved by a few hours' rest after the operation. These are only a few illustrations of the value of the great therapeutic principle of rest; the reader interested in its further applications may refer to the articles IMMOBILITY; POSITION; PRESSURE; SUSPENSION; WOUNDS, treatment of

SAMPSON GAMGEE.

RETENTION OF URINE.—When the bladder contains urine which it cannot expel, retention is said to exist.

Causes.—I. *Obstructions.*—(1) Imperforate prepuce. (2) Inflammation of the urethra. (3) Abscess in the prostate, penis, perineum, or about the rectum. (4) Stricture of urethra. (5) Hypertrophy and other tumours of the prostate. (6) Calculus. (7) Tumours of the bladder, of the urethra, and of the penis. (8) Pelvic tumours. (9) Foreign bodies in the urethra, bladder, or rectum.

II. *Direct or Indirect Interference with Nerve-supply of Muscles concerned in Micturition.*—(1) Disease or injury of the cerebro-spinal axis. (2) Hysteria. (3) Drugs. (4) Wounds and contusions of bladder or urethra. (5) Surgical operations in neighbourhood of bladder. (6) Urethral spasm.

Symptoms.—The chief sign is a distended bladder, shown by hypogastric dulness on percussion, or felt by the finger in the bowel or vagina. The patient generally complains of painful and urgent desire to pass water, with constant attacks of straining, called 'spasms.' Sometimes, during a spasm a little urine is passed, giving temporary relief, while frequently the bowel itself and piles, if present, are protruded, and the contents of the rectum evacuated. These urgent symptoms may be more or less absent, sometimes almost entirely so, and the medical man must ever be on his guard, and take care that he does not overlook a chronically distended bladder, for such oversight may lead to disastrous consequences. The cause of the retention will usually be obvious enough; but it is well to remember the following points:—(1) If under fifty years of age, the patient cannot have prostatic hypertrophy. (2) If he is over fifty, and with no history of stricture, the cause is probably prostatic. (3) If under fifty, he may have stricture and never know it, until seized with retention. (4) Should the obstruction be beyond six inches from the meatus, the case is not one of stricture.

Treatment.—Immediate relief is demanded. Usually, the patient is in great pain, and the longer the distended bladder is unrelieved the less likely is it to regain

its entire contractility. A more remote danger is rupture of the urethra or bladder, with extravasation of urine. A hot bath and an opiate may be taken, or a little chloroform inhaled, and perhaps some urine will be expelled; but usually it is well to resort at once to the catheter. To prevent or mitigate the urinary fever which frequently comes on within the first few hours after catheterism, the patient should be at once put to bed after the operation, and if his urine is healthy, an opiate should be administered (liq. opii sed. ℥xv.), and washed down by some warm demulcent drink. The use of catheters in retention of urine may be considered under the following headings:—(1) Nervous retention, (2) inflammatory retention, (3) calculi in urethra, (4) urethral stricture, (5) hypertrophy or other enlargement of the prostate.

(1) *Nervous Retention.*—Here, retention has occurred although the urethra is perfectly healthy. Either the bladder cannot act from temporary or permanent paralysis or from over-distension; or reflex nervous irritation has produced 'spasm' of the urethra, this occurring when retention follows amputation of the thigh or operations for piles or anal fistula. The simplest catheter is one of vulcanised india-rubber, about No. 7 (Eng.); if this cannot be passed, a soft French coudée or olivary catheter may be attempted; if necessary, an English gum or a silver catheter must be used.

Hysterical retention almost always occurs in women. At first, judicious indifference is best; but the case may become serious if altogether neglected. After a safe interval has elapsed, a soft gum or india-rubber catheter should be introduced, and the bladder relieved. If catheterism in any particular case is undesirable, the patient may be placed in a hot hip-bath, and a jug of cold water suddenly thrown over the back, which will often produce the desired effect. See FEMALE CATHETER.

(2) *Inflammatory Retention (Gonorrhœa, Prostatitis, Abscess).*—It is well to try to avoid the use of a catheter. The patient should be put into a very hot sitz-bath and encouraged to pass water while there. If he cannot do so he may be put to bed, and the perineum freely leeches. An anodyne draught may be given if there is much pain. A brisk purge may prove useful. If these remedies fail, then a No. 7 (Eng.) warmed, oiled, soft tapering French olivary catheter may be gently introduced. If this instrument will not pass, a No. 4 or 5 English gum catheter without a stylet may be tried. A silver catheter is rarely necessary, but

when its use has been determined upon, it will be well to administer an anæsthetic, if facilities for doing so are at hand; especially if much difficulty has been encountered, owing to the swelling of the parts or the unruliness of the patient. If the retention is due to prostatic abscess, the passage of the catheter may be followed by a flow of matter, the abscess having ruptured into the prostatic urethra.

(3) *Calculi in Urethra*.—A small English gum catheter can nearly always be inserted between the calculus and the wall of the urethra into the bladder, and the retention relieved. If the calculus is at the neck of the bladder, it may readily be pushed back into the bladder by a large blunt-ended bougie or catheter. If the stone is in the penile urethra, it may generally be easily removed by the long urethral forceps or urethral scoop. See STONE IN THE URETHRA.

(4) *Stricture Retention*.—If, from the symptoms and history of the patient, stricture is suspected, he should be desired to make, if possible, a little water. He may not prove able to make any or more than a few drops; or perhaps a little stream of water will issue. In this case, the size of the stream must be carefully noted. Next, a No. 8 or 9 blunt-ended gum bougie or catheter should be gently passed as far as it will go. This will give a general idea of the situation of the obstruction.

If it is a case of stricture, the instrument will be arrested before it has traversed the first five or six inches of the canal. If the patient has been unable to make water, or can only make it in drops, then the smallest gum elastic catheter must be employed—a No. $\frac{1}{2}$ or No. 1; or, if he has made a small stream of urine, a gum catheter of corresponding size may be selected. The stylet should be removed, the end turned up a little, and a very gentle attempt be made to insinuate the catheter, warmed and oiled, through the stricture. Should the instrument pass fairly into the bladder, the surgeon will learn by the issue of a few drops of water that all is right, and he must tie the instrument securely in. The patient may immediately be able to relieve himself, not only through but by the side of the catheter; for often, in using instruments for the relief of retention from stricture, the mere pressure of the catheter against the face of the stricture will cause urine to flow, and great relief will be afforded. If, however, the stricture is a tight one, urine will not flow outside the instrument; the water may therefore be

allowed to drain drop by drop from the catheter until relief is afforded. If this relief is delayed, and the surgeon is satisfied that the catheter is in the bladder, he need not be in a hurry to remove the instrument. The patient may be soothed by a hot bath or by an opiate draught, and in time the stricture will dilate from the presence of the inlying instrument, and urine will be freely discharged by the side of the catheter.

Should the English gum catheter fail to pass either with or without its stylet, a small French olivary catheter may be attempted. If this is not successful, then a No. 1 silver catheter must be used, the patient standing or lying down from time to time, as the surgeon thinks best. The surgeon's left forefinger in the bowel is often of assistance, and not infrequently the introduction of a catheter will be much facilitated by placing the patient under the influence of an anæsthetic. If a catheter is successfully passed, whether a soft or a silver one, it should be tied in. (For the further treatment of the case, see STRICTURE OF THE URETHRA.) Should the stricture be a very severe one, it will be a great boon to the sufferer if the surgeon can arrange for catheterism to take place in the patient's bedroom, so that, when once the catheter is passed, it can be tied in, and the treatment of the stricture commenced. Otherwise, if the catheter has to be withdrawn, the second catheterism, which is very likely to be soon necessary, may prove more difficult than the first from the swelling and possible laceration of the parts. Supposing catheterism fails, and opiates and hot baths give no permanent relief, the surgeon has the choice of several modes of giving exit to the retained urine. This question will be further discussed at the end of the consideration of prostatic retention.

(5) *Prostatic Retention*.—If the sufferer is over fifty years of age, and without any history of stricture, the cause is probably prostatic. He should stand with his back to the wall; the surgeon should sit down in front of him, and pass a well-oiled No. 7 or 8 (Eng.) vulcanised india-rubber catheter. No skill is required; if it passes, all is well; if it will not pass, it must be removed, and a No. 7 or 8 French coudée catheter tried. The operator should make some mark on this instrument, so that on looking at the proximal end he can always tell, when the bent end is in the urethra, which way the bend is turned. Holding the penis up against the patient's abdomen, and passing the first five inches of the coudée catheter

vertically down the urethra, the surgeon keeps the penis and the catheter strictly in the middle line, and the bend of the instrument always towards the patient. As about the sixth inch is pushed in, he gradually brings the penis and catheter down to the level line, and as the next and succeeding inches of the catheter pass, slowly drops the penis and catheter until they almost point to the patient's toes. As a rule this catheter will ride easily into the bladder. If it does not enter, it is very probable that the point has caught in the prostatic sinus. To disengage the point of the catheter, it is gently withdrawn for about an inch or more, and turned on its long axis so that the bent-up end points laterally to the right or left, instead of upwards as it did before. An attempt is now made to pass it into the bladder; and repeated if unsuccessful, turning the point first to one and then to the other side. Frequently this manoeuvre will prove successful.

If the *coudée* catheter will not go, a very soft-ended olivary catheter may be tried, and, if necessary, a large *coudée* (No. 12); for large instruments, although they give more pain than small ones, will often avoid, by reason of their size, an awkward place which will engage a smaller instrument. When all these instruments fail, a *bicoudée* will sometimes be successful. Here may be mentioned with praise the silk-web *coudée* catheters made in London, and of recent introduction. They are soft and highly polished, and in the writer's hands have passed when the ordinary *coudée* has failed. This is due to their softness, which makes them practically *bicoudée* catheters, and enables them to ride easily over the bar at the neck of the bladder.

If none of these catheters can be passed, the surgeon may take an English gum catheter, No. 8 or 9, and, removing the stylet, may put the catheter into any shape he likes by softening it in hot water, moulding it to his taste, and then making the shape for a time permanent by dipping the catheter into cold water. A very excellent plan is to keep one of these catheters permanently on a stylet which has been over-curved. When required for use the stylet is removed, and the catheter keeps its curve so well in the urethra, that the end will often successfully surmount the obstacle at the neck of the bladder. Another plan of using the English gum catheter, in these difficult prostatic cases, is to introduce it on a stylet. When the catheter becomes engaged at the obstruction, the instrument is held in place with the one hand, while the

other hand withdraws the stylet for an inch or two. This movement causes the end of the catheter to rise and come forward in the prostatic urethra, frequently with the happy result of entrance into the bladder.

If the operator is still unsuccessful, silver catheters must be tried, of various curves (prostatic), with the patient either standing or lying. The introduction of the left forefinger into the bowel will often facilitate the passage of these instruments by pressing the point forwards. In the use of all prostatic instruments, when once a catheter is passed, the patient must be closely watched as the water is drawn off, and the catheter at once plugged or withdrawn, should any signs of syncope arise. Speaking generally, it is unwise to draw off more than twenty ounces at the first catheterism. In all cases the patient should at once be put to bed, and for four or five days be kept warm and comfortable in the horizontal position. He must be carefully watched for a recurrence of retention, which will be sufficiently obvious. The great danger, however, consists in the patient after a few hours making some water naturally, without by any means emptying his bladder. This deceives the unwary surgeon, and the bladder is allowed to continue partially emptying itself until obstinate and even dangerous cystitis is set up. Within at least twelve hours from the first retention, with very rare exceptions, the catheter should be passed again immediately after the patient has made water, and the amount of water not passed naturally carefully noted. This amount will determine the future treatment. *See PROSTATIC HYPERTROPHY.*

In cases of difficult prostatic catheterism, the question will often arise after the bladder has been emptied—Shall the catheter be tied in or taken out? If the difficulty has been very great, and if the catheter introduced is a soft one, it may certainly be tied in, its orifice securely plugged, and the urine drawn off when necessary. Usually, such a catheter will require changing in four or five days, and it will be well to keep the interior of the bladder free from decomposing urine, by daily injections through the catheter of a warm solution of boracic acid (3 to 4 drachms of the saturated solution to four ounces of water), or of carbolic acid (℥ij. to fʒiv.). Such a proceeding is justifiable if great difficulty has been experienced, and if the urethra has been much injured; and it is occasionally justifiable in ordinary cases, if the surgeon cannot frequently visit his patient. Here, however, it may be said that, when a man has had prostatic retention

of urine his life hangs in the balance, and whether the balance goes up or down largely depends on the care his surgeon can give him, the most essential part of this care being immediate and easy catheterism directly the bladder cries out for relief. Unless under absolute necessity, a silver catheter must not be tied in. A soft catheter may usually be safely retained—and stress may be laid upon this, as formerly it was taught that a catheter should never be tied in in cases of enlarged prostate. If the retention has with great difficulty been relieved by a silver catheter, and if it is desirable to tie a catheter in, the retention of the metal instrument may be avoided by placing a soft catheter on a stylet, bending it to exactly the same shape as the silver catheter, and passing it directly the silver one is withdrawn.

With patience, gentleness, and skill, the surgeon should always succeed in passing a catheter in a case of prostatic retention. But supposing that from great irregularity of the passage, want of suitable instruments, or in consequence of injury inflicted during previous attempts at catheterism, no instrument can be introduced, what is the surgeon to do? In the first place, for obvious reasons the relief must be immediate; any delay is absolutely wrong; and in the second place the relief must be obtained by the simplest means. The simplest means of evacuating a distended bladder is, undoubtedly, by suprapubic aspiration. Afterwards, with rest and after a thorough evacuation of the bowels, a catheter may often easily be passed into the bladder through the urethra. Should retention, however, recur, and catheterism again fail, a second or even a third aspiration is permissible. But, although the bladder has been safely aspirated many times (ten or twelve), fatal extravasation and abscess have been known to follow a second aspiration, and the surgeon is advised not to aspirate the bladder more than two or three times. Afterwards, if a catheter cannot be passed, suprapubic puncture with trocar and canula is recommended.

There are other methods of puncturing the bladder, notably the rectal one, which still has advocates. These methods are all described under **BLADDER**, Puncture of the. See also **BOUTONNIÈRE**, the Operation of.

G. BUCKSTON BROWNE.

RETINA, Affections of the.—**CONGENITAL ABNORMALITY**.—Occasionally, the nerve-fibres regain, at the edge of the papilla, their medullary sheath which had been previously lost at the lamina cribrosa,

and we have the condition known as 'opaque nerve-fibres.' The papilla itself often escapes, but sometimes its periphery, and, very rarely, even its entire surface, with the exception of the physiological cup, may be involved and appear white in consequence. The condition usually occurs in the form of a brilliantly white patch, narrower at the end next the papilla, with which it is nearly always continuous. Its broader peripheral end has a ceased-out, brush-like appearance, from the separation of the fibres. The affected area is generally at the upper or lower edge of the disc, and the large blood-vessels there present are more or less concealed by it. Exceptionally, it extends all round the disc, and, still more rarely, the patch may be detached from the disc altogether. We get a scotoma corresponding to the extent of the opaque area.

DISEASES.—With the exception of its blood-vessels and its pigment-epithelium, the retina is almost perfectly transparent, and therefore practically invisible ophthalmoscopically. Its diseased conditions then may be recognised by a loss of its transparency, or by changes in its circulation or in its pigment layer.

CHANGES IN THE SIZE, COURSE, AND STRUCTURE OF THE BLOOD-VESSELS.—First, we will consider shortly disturbances of the retinal circulation, as evidenced by changes in the size and course of the vessels and in the structure of their walls.

In judging of the *size* of the retinal vessels we regard chiefly the larger branches on the optic disc, comparing them with the mental impression of those of an average normal eye. Slight departures from the normal may readily be overlooked by such a method, and the observer must be careful to note the number of the branches of artery or vein on the disc, as, the smaller the number of these, the larger each one will be in proportion in the healthy fundus. Again, by the direct method of observation, the vessels will appear larger in the myopic and smaller in the hypermetropic eye, while by the indirect method the opposite effect will be produced (**OPHTHALMOSCOPY**). It is important to observe any change in the relative size of arteries and veins, the diameter of the normal artery being from two-thirds to three-fourths that of the corresponding vein.

A congenital general enlargement of the retinal vessels, containing unusually dark blood, is met with in congenital defects of the heart with cyanosis. A temporary distension of the retinal vessels exists in active hyperæmia, as from vaso-

motor influence in exophthalmic goitre, local overfilling from obstruction in another arterial region, &c. A general reduction in the size of the vessels is sometimes found in general anæmia and in Bright's disease, or it may be due to local pressure on the central artery. The arteries alone may be small in cases of neuritis and of embolism, and occasionally in general anæmia, where the veins appear large from being flattened, owing to their reduced intravascular tension. In true venous distension we find these vessels large, rounded, abnormally dark, and tortuous. This condition of venous distension may be dependent on local or general causes. Locally, it may be due to neuritis, or thrombosis of the central vein, and is found sometimes in glaucoma and in cases of rapidly occurring pressure on the cavernous sinus. The retinal veins may be congested, as part of a general venous congestion in the head from pressure on the jugular or innominate veins. Again, the retinal congestion may be part of a general congestion, the latter being either *acute*, as from coughing or any effort, or *chronic*, as in mitral disease and emphysema of the lungs. An irregular dilatation or varicosity of the veins is sometimes observed in aged persons and in glaucoma.

A *tortuous course* is characteristic of congested veins, but it has exceptionally been found with normally sized vessels in healthy eyes. An antero-posterior curve in the vessels may be caused either by swelling or detachment of the retina, and is recognised mainly by loss of the central light-streak.

Visible pulsation in one or more of the large veins on the disc is not uncommon in the normal condition, and is best seen just at the edge of the physiological cup. It also occurs, pathologically, from the same causes that produce arterial pulsation. This latter is never normally present, but occurs in acute anæmia, in aortic regurgitation, and in increased intra-ocular tension, whether from disease or mechanically produced by finger-pressure from without. It is usually visible only in the vessels on the disc itself, but in aortic cases it may be traced peripherally to branches of comparatively small size.

Changes in the vascular walls are sometimes recognisable by the ophthalmoscope, a distinct white line bounding each side of the red blood-column. This appearance may be due to thickening of the middle or outer coat of the arteries, or to an accumulation of leucocytes in the peri-vas-

cular sheath. Aneurisms may occur either on the primary branches of the central artery, or on the smaller twigs and capillaries of the retina. They are of clinical importance from their being usually associated with a similar condition of the small vessels in the brain and elsewhere.

Apart from circulatory changes, we may diagnose retinal affections by an interference with its normal transparency. Thus, we may have diffuse haze from oedema, red patches from hæmorrhages, black opacities from deposits of pigment, or opaque white areas from exudation or fatty changes. Again, it and its vessels may be elevated in part of the fundus as the result of an exudation or solid growth beneath.

HÆMORRHAGES may occur in the retina at any part of the fundus, and are readily recognised, when recent, from their bright red colour. There may be only one or two, or they may be practically countless; and they may be of any size, from a barely visible spot or streak to a patch much larger than the optic disc. Occasionally, a single, large, round or oval, sharply defined hæmorrhage occurs at the yellow spot. Hæmorrhages are most commonly found in the neighbourhood of large vessels in the nerve-fibre layer, and then present a striated or 'flame-shaped' appearance, from the extravasated blood lying between the nerve-fibres. Not infrequently they occur in the inner nuclear layer from the fine capillary networks found in this position, and they are then round or irregular in form. If large, they may either burst into the vitreous or cause detachment of the retina. They interfere with sight according to their size and position; those at the yellow spot causing necessarily a large central scotoma. They become darker in colour with time, and absorption takes place gradually, its rapidity being greatest in hæmorrhages of small size and in those not associated with disease of the vessels. Ultimately no trace may be left, or there may be dark pigmentation or again yellowish-white spots.

Causes.—We may meet with them as part of an inflammation of the retina or optic nerve, but more frequently they are dependent directly on general conditions, or on retinal disease consequent on general conditions. The extravasation may be due to rupture of vessels or to diapedesis. The following statement will serve to show the manner of their occurrence.

A. Rupture of vessels from—

1. Increased intravascular pressure, local or general. (a) *Local*—e.g. from contusion of eyeball, venous thrombosis, optic

neuritis with much constriction of veins, and all forms of retinitis. (b) *General*—as from hypertrophy of the left ventricle, cough or other violent effort, stoppage of habitual discharges, the high arterial tension associated with gout, &c.

2. Rupture from sudden diminution of the vitreous support, as in wound of the globe and in iridectomy for glaucoma.

3. From weakness of a degenerated vascular wall, as in sclerosis, fatty degeneration, or miliary aneurisms of the retinal vessels; sometimes associated with embolism or thrombosis of the small arteries. The vascular change may be a simple senile condition, or may be a concomitant of a general affection such as Bright's disease.

B. Diapedesis may be the result of—

1. Increased intravascular pressure, or

2. An altered condition of the blood.

This latter is probably responsible for the hæmorrhages found in cases of diabetes, severe anæmia, leucocythæmia, ague, purpura, scurvy, and pyæmia. Retinal hæmorrhages are occasionally met with in young people without any obvious cause. Such cases are probably due to increased intravascular tension and altered conditions of the blood. They are commonly found in association with the hæmorrhagic diathesis.

The *treatment* of hæmorrhage of the retina must necessarily vary with the general and local states with which it is associated or on which it depends. In recent cases iced compresses may be applied to the lids.

INFLAMMATION OF THE RETINA is usually the result of some general disease, and the classification of its forms commonly adopted is clinical rather than pathological. When the inflammation commences in the retina the papilla is generally secondarily involved, and, again, retinitis—mainly of the inner layers, is not infrequent in cases of papillitis. The principal ophthalmoscopic evidences of retinitis are loss of retinal transparency, dilatation of the veins, and a tendency to the occurrence of hæmorrhages and white patches. Anatomically, we find serous infiltration of the retina, swelling of the Müllerian fibres, fatty degenerations, inflammatory exudations, hæmorrhages in the inner or middle layers, and hypertrophy and sclerosis of nerve-fibres. Sometimes there are numerous opacities in the vitreous. The impairment of vision, both temporary and permanent, varies much in different cases.

The *treatment* must be regulated mainly by the general condition of the patient. All strong light should be cut off from the eyes

by wearing dark neutral-tint glasses, and complete rest be ordered. Counter-irritants or leeches to the temples may be advisable.

HÆMORRHAGIC RETINITIS is the term applied to cases where we have numerous hæmorrhages along with evidence of retinal inflammation, occurring in association with disease or disorders of the circulatory system. It usually affects one eye only. The hæmorrhages are small and numerous, and are found widely distributed over the fundus, chiefly in the inner layers of the retina. The papilla is hyperæmic, with blurred margins; there is a slight diffuse opacity of the retina, and its veins are dark and swollen. Occasionally, we find a few circumscribed white spots in the inner retinal layers, probably due to fatty degeneration or to aggregation of leucocytes.

Causes.—This disease is found in connection with diseased cardiac valves, hypertrophy of the left ventricle, aneurism of the great vessels, and with arterial sclerosis. It also sometimes occurs on sudden suppression of the catamenia at the climacteric period. The manner of its production is obscure. It may perhaps be explained by chemical changes in the blood, or by multiple embolism of the small twigs of the central retinal artery. There are usually permanent changes left in the retina and papilla.

The *treatment* must be general; iodide of potassium may be used with apparent advantage.

ALBUMINURIC RETINITIS is characterised by the presence of numerous light-coloured patches, and of minute, opaque, very white dots or striæ at the yellow spot. The affection of the papilla varies between slight passive congestion and great engorgement; in the latter case there is a marked tendency to hæmorrhages, which occur principally in the nerve-fibre layer. The soft-edged light-coloured patches occur early, and are found mainly in an annular zone surrounding the papilla. The white punctate spots appear later, and are arranged in the form of a star or asterisk, with its centre at the fovea centralis. Both eyes are practically always affected. The large light patches are usually behind the retinal vessels, and are due to a deposit of fatty granules in the nuclear and internuclear layers. When superficial to the vessels, the opacity is caused by a local hypertrophy of the nerve-fibres. The white dots at the macula are due to a fatty degeneration of the inner ends of the Müllerian fibres.

Causes.—This retinitis is most commonly associated with chronic disease of the kidney, especially the contracting form, but it

is also frequently found in the albuminuria of pregnancy and not uncommonly in acute nephritis after scarlatina. It has been observed in about 13 per cent. of all cases of albuminuria. The occurrence of the ocular changes is probably to be explained by the altered condition of the blood, arising from retention of products that ought to be eliminated and from the hydremia produced by the loss of albumen. We may have a papillitis or a papillo-retinitis, in connection with albuminuria, without the typical appearance above described. On the other hand, retinitis quite of the albuminuric type occurs exceptionally in connection with intracranial affections, cardiac disease, diabetes or anæmia, without there being any evidence of renal disease.

If improvement takes place in the renal affection the retinal changes may subside, but the star-shaped grouping at the macula lasts for a long time. We often ultimately get optic atrophy, narrowed vessels with double white lines, and disturbances in the retinal pigment. Sometimes, we get a restoration of perfect vision with a normal fundus, as in the cases associated with pregnancy.

SYPHILITIC RETINITIS.—This is an inflammation of a chronic diffuse type without gross ophthalmoscopic changes. The larger veins are somewhat distended and dark, and the outline of the papilla is blurred. The retina itself becomes hazy, especially in the neighbourhood of the papilla and along the larger vessels. White patches and hæmorrhages are rare. Very commonly there are numerous dust-like opacities in the vitreous. It generally occurs secondarily to choroiditis, but may exist alone, and either in one or both eyes. It usually comes on late in the secondary stage, about the end of the first year or later, and is most common in subjects of mature or advanced age. It has been also met with in the congenital form of the disease.

Symptoms and Course.—There is considerable failure of vision, sometimes micropsia, and always marked night-blindness. It lasts for months, but the result is generally favourable, the retina recovering its transparency and the other changes disappearing.

The *treatment* must be energetically anti-syphilitic, mercury being the remedy chiefly to be relied on.

RETINAL DISEASE IN LEUCOCYTHÆMIA occurs in about one-third of the cases of the splenic form. It is always bilateral, but often unequal in degree in the two eyes. In a typical case, we find prominent white

patches surrounded by a hæmorrhagic border: these are met with at the limits of the retinal circulation—viz. in the centre, and quite at the periphery of the fundus. The general fundus-reflex is of a bright orange-yellow colour; the retinal arteries are bright orange and the veins light carmine. The usual signs of retinitis are also present, such as blurring of the edges of the disc, slight opacity of the retina, and occasionally small hæmorrhages and white spots.

RETINAL DISEASE IN DIABETES occurs comparatively rarely, but is always bilateral. Usually we simply find retinal hæmorrhages in this association, but, in severe, long-continued cases, retinitis may occur with appearances much like what we find in albuminuria. In the diabetic form, however, the whitish patches are generally smaller, and there are very frequently opacities in the vitreous. Vision is necessarily much reduced in all severe cases, and the prognosis is unfavourable.

CENTRAL RETINITIS FROM EXPOSURE TO DIRECT SUNLIGHT has been met with in several cases after observation of an eclipse. Immediately after the exposure there is more or less loss of central vision, in the form of a positive scotoma. In severe cases this persists, though generally some improvement takes place. Ophthalmoscopically, the macula is found to be more darkly pigmented than usual, and the position of the fovea is occupied by a greyish-yellow spot. It is probable that the pathological changes consist in proliferation of the pigment-epithelium, and exudation between it and the chorio-capillaris. In severe cases with persistent scotoma, there is possibly also destruction of the outer segments of the rod and cone layer.

The *treatment* consists mainly in the use of dark glasses, and leeches or counter-irritants to the temple. Later, strychnine and galvanism have been recommended.

RETINITIS PIGMENTOSA is a term in common use to designate a disease where a certain group of symptoms and definite course are usually found in association with pigmentary changes in the retina. The disease is symmetrical and chronic, usually beginning in early life, and often terminating in blindness soon after middle age. Night-blindness is the earliest and most characteristic symptom. There is next loss of visual field, generally at first in the form of an annular scotoma, but the periphery soon also fails, and a small central field alone remains. Central vision may remain good for a long time. The

affection is often found in several members of the same family, and such patients are not infrequently defective in intellect. It is believed by some that consanguinity of parents may produce it.

Ophthalmoscopic examination shows a yellowish-red waxy atrophy of the optic disc; marked diminution in size of the retinal vessels, especially the arteries; and much pigment in the retina, largely in its inner layers, where black masses, shaped somewhat like bone-corpuscles, lie superficial to the retinal blood-vessels. This pigmentary deposit is found chiefly in a belt situated midway between the centre and the periphery of the fundus, and thinning out at each edge. There is no hyperæmia at any period of the disease. No constant relation exists between the amount of pigment or other ophthalmoscopic change and the loss of sight; indeed, we may have the usual symptoms and course of the disease without the presence of any abnormal pigment in the retina. Similar changes in the retina and optic nerve are found, not infrequently, secondary to choroidal inflammation, but in such cases we have the atrophic changes in the choroid in addition. Ophthalmoscopically considered, pigmentary degeneration of the retina is essentially the same from whatever cause it may arise. But the term *retinitis pigmentosa* has been chiefly used as a clinical designation, and as denoting the group of symptoms, course, and ophthalmoscopic appearances of, practically, the only form of pigmentary degeneration which can occur without retinitis; while the symptoms and course of this disease may be present without the usually associated pigmentary degeneration. The condition is in reality a chronic sclerosis, occurring either as a primary disease or secondary to intra-ocular inflammation, and generally, but not always, associated with a pigmentary degeneration of the retina. Pathological examination of the retina shows an increase of the connective-tissue framework, atrophy of the nervous elements, and thickening of the walls of the vessels.

The pigmentary changes are partly atrophic in nature, but mainly consist in an infiltration of the retina with newly formed pigment aggregations. These latter follow the course of the vessels, and are found most conspicuously at their branchings.

Galvanism is the only form of *treatment* of any avail in this affection, sometimes causing a marked improvement both in field and in central acuity. It ought to be employed as described previously (*see* OPTIC NERVE, Atrophy of), and if it prove ser-

viceable, should be persevered with, as otherwise the improvement cannot be expected to last long.

THROMBOSIS may occur in the central artery, but it is rare, and indistinguishable during life from embolism. Occasionally, thrombosis affects the central vein behind the eyeball or one of its large branches on the fundus, and usually leads to deterioration of vision and marked ophthalmoscopic appearances. The sight fails suddenly, and more or less completely according to the extent of the closure and the size of the vessel affected, but generally it soon improves again somewhat. In a marked case, the veins of the retina are found to be tortuous and enormously distended, the arteries often small, and both sets of vessels near the disc are concealed in great measure by large opaque, white, diffuse masses of exudation and by numerous hæmorrhages. The latter are of all sizes here, and smaller ones extend well out to the periphery of the fundus. The yellow spot region is of a light clay-colour, with the fovea centralis conspicuous as a very minute cherry-red spot. The papilla looks normal, with the exception of slight blurring of its margins. The affection occurs principally in the aged, often with a family history of gout, and nearly always in only one eye.

EMBOLISM may occur in the central artery itself or in one of its branches, and may be either complete or partial. It is seldom bilateral, and is more common on the left than the right side. Embolism in other vessels always co-exists, the usual cause being heart-disease, especially mitral. It may be found in association with atheroma of the aorta, pregnancy, and Bright's disease, and may consequently occur at any age. In complete embolism the plug is generally near the lamina cribrosa, and the leading symptom is sudden blindness of one eye. There is frequently a temporary improvement a few hours after its occurrence, from the establishment of an imperfect collateral circulation, but the usual final result is absolute blindness. In plugging of a branch, the visual defect is usually partial from the first, the final result likewise being loss of vision corresponding to the distribution of the affected vessel.

Ophthalmoscopic Appearances.—The optic disc is pale, with somewhat blurred edges. There is a diffuse, misty opacity of the retina from œdema, best marked in the yellow spot neighbourhood. Corresponding to the fovea centralis is a bright red spot, where the normal choroidal reflex shines through the outer layers of the retina, and

appears specially red by contrast with the surrounding cloudiness. The large vessels are usually small near the disc, the arteries being often reduced to mere white threads or to narrow red blood-columns bounded by opaque white lines. Within the first day after the occurrence of an incomplete blocking of the vessel, the blood may be seen both in the arteries and veins in the form of short detached columns. This appearance is most common in the arteries, where the short columns may be observed to move forward in a jerky fashion. Increased tension from finger-pressure cannot produce visible pulsation in the vessels. Small hæmorrhages often occur near the optic disc. After some days the pulsation on pressure returns in all the blood-containing vessels, the retinal œdema slowly disappears and the disc gradually becomes atrophic. Where a branch only is affected, changes similar to the above are found in its area of distribution.

As regards *treatment*, massage of the eyeball has proved beneficial in several cases, and should be tried. It is probably best effected by alternate, prolonged, moderately firm pressure on the globe and sudden removal of this pressure.

DETACHMENT OF THE RETINA.—In this condition the retina proper is separated from its pigment epithelium, and a serous fluid usually occupies the interval. Except at the fovea centralis and ora serrata, the retina is naturally very loosely attached to its epithelium; and fluid once present between them readily gravitates downwards to the lower part of the fundus, where old standing detachments are most commonly found. Occasionally, the displacing agent is an extravasation of blood, or a solid plastic exudation from choroiditis, or a choroidal tumour pushing the retina forward. Sub-retinal fluid may be effused, primarily, either as a hæmorrhage or as a serous exudation in connection with inflammation or tumour of the choroid. The common reason of detachment, however, is probably some alteration in the vitreous—either a mere diminution of its support to the retina, or contraction of connective-tissue formations within it forcibly dragging the retina away from its normal position. In such cases the sub-retinal effusion of fluid is secondary.

One of the most common *causes* of retinal detachment is progressive myopia, where we have both choroidal inflammation and alterations in the vitreous. Perforating wounds of the sclerotic may lead to detachment, either immediately, from a loss of vitreous, or subsequently, from contraction

of the cicatricial tissue at the seat of puncture. In many cases no cause can be discovered.

Anatomically, the detached retina undergoes a gradual degeneration, the nervous elements being destroyed and its connective tissue hypertrophied.

Ophthalmoscopic Appearances.—On illuminating the patient's eye with the ophthalmoscopic mirror held at twelve to eighteen inches distance, we observe a want of uniformity in the reflex obtained, a greater or lesser extent of the fundus appearing bluish-grey or whitish in contrast to the normal red seen elsewhere. This discoloured portion is usually folded and more or less tremulous, and corresponds to the detachment; on its surface we see the retinal vessels as slender, dark, stiff-looking tortuous lines. In a recent shallow detachment we find no such difference in colour, but its vessels have the characters just mentioned, though they stand out less conspicuously, from the absence of the strong contrast furnished by a light-coloured surface. By careful measurement of the refraction of the vessels, on the affected and unaffected areas of the retina, we can estimate the depth of the detachment, and in difficult cases determine whether really a displacement exists. Having satisfied ourselves of the presence of a detachment, we should note its extent and the character of its boundaries, its mobility on movements of the eye, its colour, its depth, and the degree of folding. We are thus in a position to decide as to the probable nature of the displacing agent. Not infrequently, floating opacities in the vitreous, changes in the lens, or iritic adhesions are present and interfere with our examination; under such circumstances the indirect method of observation is particularly valuable. The grey colour of a detachment is due to the opacity of the retina; the darkness of the blood-vessels is due partly to loss of the central light-streak, partly to contrast, but mainly to the fact that they are principally seen here by *transmitted* light, the greater part of which is absorbed by the blood-column.

Symptoms.—There is frequently a history of sudden impairment of vision, objects appearing distorted or as if covered by a thick black veil. Sometimes we have complaints of flashes of light and of red or blue colour-sensations. Light is diminished in the part of the field corresponding to the detachment. Central vision may remain good for some time if the macula has escaped; but, in the majority of cases, the detachment extends gradually, and the sight

becomes progressively worse until, ultimately, there is complete blindness or only the barest perception of light.

Treatment.—In recent cases we can often get satisfactory improvement of vision for a time at least, though the measures most successful are decidedly irksome. Rest in a dimly-lighted room is particularly to be recommended, the patient lying on his back on a bed or couch, and the affected eye kept covered with a pressure-bandage. All exertion or sudden effort must be avoided, and the bowels are to be carefully regulated. Puncture of the sclerotic at the site of the displaced retina, so as to permit of the escape of the sub-retinal fluid, is, possibly, a judicious preliminary to the above method of treatment. Repeated sub-cutaneous injections of pilocarpine have also been used and approved of by many, but their employment is not without risk, and the advantage problematical. Neither puncture nor pilocarpine ever does much good without rest, and it is extremely doubtful whether the latter alone does not give results as satisfactory as any.

GLIOMA OF THE RETINA is essentially a disease of early life. It commences insidiously without inflammation, grows rapidly, and, if left to itself, soon leads to the death of the child. By its growth forwards it soon fills the eyeball, perforates the sclerotic or corneal margin, and involves the other orbital structures, so that, finally, we get the appearance of an enormous red fleshy protrusion without any visible trace of the globe itself. In its extension backwards it travels along the optic nerve, and ultimately involves the brain—not infrequently it causes secondary deposits in the scalp, brain, the neighbouring lymphatic glands, and occasionally in the liver and other distant parts. Rarely it attacks both eyes independently. It has occasionally been met with in several members of the same family.

Diagnosis.—In as far as its onset is painless and unaccompanied by inflammation, the attention of the parents is generally first aroused by seeing a whitish reflex from behind the pupil. The vision is commonly very early affected, while the eye still looks natural and the tension remains normal. By the time the whitish reflex is observed, however, there are often signs of secondary glaucoma, increased intra-ocular tension, dilatation of the pupil, and engorgement of the scleral veins, while the eye is now sometimes tender. By focal illumination we see a yellowish-white, rounded or lobulated, solid-looking mass in the vitreous,

with blood-vessels and often small hæmorrhages on its surface. The vessels are easily distinguished from those found on a detached retina by their irregular distribution, different mode of branching, greater breadth, and somewhat brighter red colour.

Pathology.—Its naked-eye appearance is that of a soft, marrow-like growth, of a whitish or reddish-white colour, sometimes studded with small, white, chalky-looking dots. The formation originates in the neuroglia of the retina, usually in that of the inner granular layer. We find here deposits of small roundish cells, closely packed together in a structureless, finely granular interstitial substance. Later on, as the tumour grows, we find large groups of spindle-shaped cells and fibrillated bands (gliosarcoma), and occasionally evidences of fatty and calcareous degenerations.

The *treatment* consists in early removal of the affected eyeball, along with as much nerve as we can conveniently get at. If the other orbital contents are affected while the nerve at the point of section appears healthy, it is advisable to thoroughly clean out the orbit and then destroy the surface with chloride of zinc paste. If the tumour has attained a large size, its removal cannot be expected to save life, and it is often advisable in these circumstances to leave it alone. In such a case, the child's health must be kept up as well as possible, and opiates given, if necessary, to relieve pain and induce sleep. R. MARCUS GUNN.

RETINOSCOPY (Keratotomy).—(In this article the following abbreviations are used:—M. = myopia or myopic, H. = hypermetropia, As. = astigmatism, E. = emmetropia, D. = dioptré, v = vision.)—Retinoscopy is a method of determining by the ophthalmoscope the nature and extent of anomalies of refraction of the eye. It depends on the following optical facts. Supposing a patient, with artificially dilated pupil, seated in the ordinary position for ophthalmoscopic examination, and that we place ourselves at about forty-eight inches from him and reflect the light from a well-defined gas-flame into his eye, by means of a *concave* perforated mirror of about nine inches focal length. If we then look through the perforation in the mirror, we see the ordinary fundus-reflex. Now, if we give the mirror slight rotations about its vertical axis, so that it faces in different directions, still remaining in front of our eye, we then see something that has the appearance of a shadow with a vertical edge, moving horizontally across the illuminated area of the

patient's pupil, either in the same direction as the mirror changes face or in exactly the opposite direction. If, for instance, we turn the mirror to our right, the shadow moves horizontally, either to the right or to the left. Now, if it moves to the right—i.e. in the direction in which the mirror changes face—the patient's eye is M.; if it moves to the left—i.e. in the opposite direction to that in which the mirror changes face—the eye is (generally) H.; if no distinct shadow-movement is seen at all, the eye is E. (nearly).

The observation just described is the germ of retinoscopy. It is convenient to use the terms 'with' and 'against' in describing the movement of the shadow with reference to that of the mirror; for the future, then, we shall speak of the shadow moving 'with' or 'against' the mirror, according as it moves in the same or opposite direction to the change of face of the mirror.

It may be shown that this so-called shadow is really the edge of the image of the gas-flame, formed by one reflection at the mirror and two refractions through the patient's eye, and further, that the change from movement 'with' to movement 'against' takes place, not where the patient's eye is exactly E., but where it is M. about 1.0 D; but as this does not differ much from E. we may say roughly that in M. the shadow moves 'with' the mirror, in H. 'against' the mirror, and that in E. no distinct shadow is seen at all. We have supposed that the mirror is rotated round its vertical axis; this, however, is not at all essential; any axis will do, but perhaps the vertical or horizontal is most convenient. Further on, when we come to treat of As., we shall have to suppose rotations round various axes, and it will be conducive to clearness to abandon altogether this term—rotation round an axis—and speak of the mirror being turned in the direction of a certain meridian of the patient's cornea, this meridian being the one perpendicular to the axis round which the mirror is rotated. Thus, when we speak of the mirror being turned in the horizontal direction, we mean that it is being rotated round its vertical axis; when we speak of its being turned in a direction up and *in* at an angle of 30° with the vertical, we mean that it is being rotated round an axis inclined up and *out* at an angle of 30° with the vertical. Adopting, then, this phraseology now, we say that in cases of M. or H. the shadow moves in the same direction ('with' or 'against') in which the mirror is turned. Further, the edge of the shadow is perpen-

dicular to the direction in which the mirror is turned. It must also be stated here that the above phenomena as regards 'with' and 'against' apply to a *concave* mirror only; with a plane or convex mirror, the directions in which the shadow moves are reversed. We can then by this method at a glance diagnose the *quality* of the refraction; but, further, we can estimate its *quantity*. To do this it is only necessary to fit the patient with a trial-frame, and put in it lenses to correct the refraction—i.e. concave or negative lenses in the case of M., convex or positive in the case of H.; in either case we find what lens causes the shadow-movement to disappear.

We know that now the eye *plus* the lens forms an emmetropic (nearly) combination, and the strength of the lens gives the amount of M. or H. The correct lens is in many cases found only after several trials, but a little practice will often enable the observer to make an approximation to it at once. With this view, he should note especially the *intensity* of the fundus reflex; if this be bright, the case is one of low ametropia (whether M. or H.); if it be dull, it is a case of high ametropia. To take an example:—

The patient's eye shows a dull fundus-reflex, and the shadow moves 'with.' The case then is one of high M. We put up a lens of, say, -7 D in the trial frame. The reflex is now much brighter, and the shadow still moves 'with.' 7 D is then not strong enough to connect the M.; we put up -9 D, and now we get no shadow at all; the amount of M. is then 9 D (nearly). On trial with test-types at twenty feet, we find the M. is actually 10 D, rather more than we found by retinoscopy; this results from the fact mentioned above, that the condition in which no shadow at all is seen is not one of exact E. but of M. of about 1 D. In all cases, it will be found that the actual M. is about 1 D *greater* than that indicated by retinoscopy, and (for the same reason) the actual H. about 1 D *less*.

To proceed now to the phenomena of retinoscopy in *Astigmatism*. In M. and H. we have seen that the direction in which the mirror is turned is immaterial, a shadow-movement being procurable in any meridian by turning the mirror in the direction of that meridian. In astigmatism, however, we get a shadow-movement in the direction of the two principal meridians *only*, and this no matter in what direction the mirror is turned. It follows that if the mirror be not turned parallel to one of the principal meridians, the consequent shadow-

movement is not parallel to the direction of turning of the mirror. This fact at once indicates that astigmatism is present, and reveals the directions of the principal meridians. These being ascertained, we proceed to examine their refraction, turning the mirror for that purpose in the direction of each of them successively. With a little practice this can be done pretty accurately, the direction in which the mirror is being turned being shown by the direction in which the circular patch of light (reflected from the mirror) travels across the patient's face. Take one of these chief meridians: Turning the mirror in its direction, we have, as a criterion of its refraction, a shadow moving parallel to it, and with edge perpendicular to it. All that has been proved of the shadow in any meridian in the non-astigmatic eye is true of this one meridian in the astigmatic: the movement of the shadow shows whether the meridian is M. or H., and the strength of glass necessary to cause the shadow to disappear gives the amount (nearly) of the M. or H. We note the lens required, and then proceed to examine in the same way the other chief meridian. Having thus determined the refraction of the two chief meridians, we put in the trial-frame the indicated spherocylindrical combination, and try the patient with the test-types at twenty feet. To get the best vision, we expect to have to slightly strengthen the spherical lens in M., and weaken it in H., and other slight changes in the strength of the cylinder and the direction of its axis may be necessary before the most satisfactory result is obtained. But, as a rule, the lens indicated by retinoscopy comes very near to the one finally chosen.

Take a case. Right eye. Dull fundus-reflex. Shadow moves 'against.' With + 8 D a well-defined shadow moving 'with' the mirror in meridian 45° up and out; no shadow seen in meridian perpendicular to this; that is, + 8 D corrects this latter meridian, + 6 D gives no shadow in meridian 45° up and out, and a faint shadow moving 'against' in meridian perpendicular to this—that is, + 6 D corrects the former meridian, $\frac{+6\text{ D}}{+1.50\text{ D cyl.}}$, axis 45° up and out gives no shadow in any meridian. The lens that gives the best vision is $\frac{+5.50\text{ D}}{+1.50\text{ D cyl.}}$, axis 50° up and out, and with this $\frac{6}{9}$ is read, v without the cylinder being only $\frac{6}{36}$.

Very often in cases of compound astigmatism the As. is not evident at first, and only appears when, in the course of correcting the apparently simple spherical anomaly, we put up a lens that nearly corrects one meridian; the shadow in the other meridian then stands out clearly. Mixed astigmatism is diagnosed at a glance, the shadows in the two chief meridians moving one 'with,' the other 'against.'

In conclusion, a few practical hints may be given. A mydriatic is often necessary, especially in cases of astigmatism. Where a mydriatic is not used, the patient should be directed to turn his eye so that the light from the mirror falls on the optic disc; in this way the greatest dilatation of the pupil is obtained. The surgeon should get into the habit of sitting always at about the same distance from the patient, and using the same intensity of light.

A dull fundus-reflex, suggesting high ametropia, may be caused by pathological changes in the media of the eye.

Irregular, broken shadows generally mean opacities of the cornea.

The retinoscopic examination must, generally, be considered only preliminary to the usual test with lenses and types at twenty feet.

A much fuller account of the method, especially in its theoretical aspect, is to be found in the *Royal London Ophthalmic Hospital Reports*, vol. x. part iii.

W. CHARNLEY.

RETRO-NASAL CATARRH is a chronic inflammatory condition of the mucous membrane lining the naso-pharynx and the posterior part of the nasal cavities. It is frequently associated with chronic nasal catarrh and granular pharyngitis. Several varieties have been described, such as the follicular, the hypertrophic, and the dry catarrhal, but they would appear to be merely stages of the same disease, and are here treated as such.

The cause of the catarrh is not altogether understood. The extension of chronic catarrh from the nose or pharynx, frequent exposure to alternating draughts of hot and cold air, the irritation of particles of dust, which are particularly apt to become lodged in this portion of the respiratory tract, and direct contagion have been regarded as exciting causes; whilst struma, syphilis, and residence in hot and damp climates are thought to predispose to it. It is much more common in America than in this country, and is there thought by Dr. Robinson to depend upon a 'catarrhal diathesis.'

Pathology.—In the earlier stages of the disease, there is simply a catarrhal inflammation of the mucous membrane; later, the mucous membrane and submucous tissue become infiltrated with inflammatory products, and the glands enlarged and stimulated to over-production, when the hypertrophic stage, or the follicular variety, of the disease is reached. Still later—it may be after a few months or many years—the mucous membrane, in consequence of the contraction of the inflammatory exudation, shrinks and atrophies, whilst its glands are destroyed to a greater or less extent. The parts now appear glazed and dry from deficiency of secretion; and in this atrophic stage the disease is spoken of as dry catarrh.

The *symptoms* vary according to the stage of the disease, but space does not permit of their being given in detail. In a well-marked case, say in the hypertrophic stage, the period at which the surgeon is perhaps most frequently first consulted, the chief complaints are of a feeling of stuffiness and obstruction at the back of the nose, a constant hawking up of a viscid, mucopurulent secretion, sometimes streaked with blood, and a peculiar alteration in the voice. At first there may be no fetor, but later the breath, in consequence of the decomposition of the secretion, becomes peculiarly foul, and is then one of the patient's chief annoyances. Headaches, especially in the occipital region, deafness, and dyspepsia where the mucus is allowed to pass into the stomach, may also be present; and epistaxis may from time to time occur. Should chronic nasal catarrh co-exist, there will likewise be a discharge, and often an offensive one, from the nose.

On looking into the throat, the mucopurulent secretion will often be seen trickling down the posterior wall of the pharynx, which may present the characteristic appearances of granular pharyngitis. In the rhinoscope, the mucous membrane of the naso-pharynx, and especially that about the vault, appears thickened and often paler than natural, while the hypertrophied glands give it a peculiar mammillary and granular appearance, similar to that of granular pharyngitis. The mucous membrane lining the posterior pillars of the fauces, the back of the palate, and the orifice of the Eustachian tubes, usually presents similar changes, whilst that covering the sides of the septum is frequently cedematous, and that over the posterior ends of the inferior spongy bones greatly hypertrophied. The hypertrophied ends of these bones appear in some instances

as distinct tumours, having a globular shape and a purplish-red colour, and, together with the cedematous septum, may completely occlude the choanæ. The above condition of the mucous membrane is often obscured by the presence of the viscid mucus, and it may not be until this has been removed with the spray or syringe that the actual state of the parts can be made out. In the atrophic stages of the disease, the naso-pharynx appears more roomy than natural, and glazed and dry; whilst the mucopurulent secretion, in consequence of the atrophy of the glands, is not cast off, but becomes inspissated, forming greenish and adherent crusts, beneath which the retained secretion undergoes decomposition and gives rise to the horrible smell. The nasal chambers, if involved in the disease, present similar appearances when viewed from the front. Ulceration does not usually occur in the course of chronic retro-nasal catarrh. Should such be observed in the rhinoscopic mirror, the case will probably be one of a syphilitic nature, and dead bone will, in the majority of instances, be discovered if further search be made for it.

Treatment.—This should be both constitutional and local. When convenient, the patient should reside in a dry and equable climate, and all sources of irritation, —as dust or noxious vapours, alternations of heat and cold, and tobacco and spirits—should be avoided. Internally, cubebs, which appears to have a marked influence on the secretions of the pharynx, should be given in large doses, and chloride of ammonium, ammoniacum, arsenic, salicylic acid, and sulphur may be tried. Where there is evidence of syphilis or struma, appropriate remedies should of course be given. Locally, the parts should be frequently cleansed by weak carbolic or alkaline sprays, and subsequently astringed by sprays of sulphate or chloride of zinc, or tannin; or by the insufflation of powders of eucalyptus (1 part to starch 2 parts), iodoform, catechu, and the like. These remedies should be applied by the brush, the insufflator, or the post-nasal spray apparatus, the nozzle of which must be passed well behind the palate. Syringing, except when the crusts are very adherent, is to be deprecated, and the nasal douche should on no account be employed, as its use is not only attended by the risk of setting up disease in the middle ear, but it also induces a soddening of the mucous membrane, and does not reach the whole of the affected parts.

Where there is much hypertrophy of the posterior ends of the inferior spongy bones,

these should be scored with the post-nasal galvano-cautery, directed by the mirror, and the scoring repeated at intervals of a week to a fortnight, till the parts have been reduced to their normal size. Or, if preferred, the hypertrophied tissue may be removed at one sitting by Jarvis's snare, the wire of which is passed through the nostril, and guided over the end of the spongy bone by the finger behind the palate. Local anæsthesia should be induced by painting a 20 per cent. solution of cocaine over the mucous membrane before using the galvano-cautery; but chloroform had better be given if the snare is used. Should a hypertrophic condition of the mucous membrane of the anterior portions of the nasal cavities also exist, the galvano-cautery should be applied to the inferior spongy bones, the septum being protected by Shurley's ivory speculum; or the hypertrophic mucous membrane may be removed from over the inferior spongy bone by Robinson's forceps; or the whole bone cut away by the nasal pliers. The author can speak from personal experience of the value of the galvano-cautery in these cases, and much prefers it to the rougher treatment with the forceps or pliers. At the same time, he is bound to say that he has never seen any harm follow the evulsion of the inferior spongy bone, and this treatment is certainly more rapid than that with the galvano-cautery.

When the disease has reached the atrophic stage, a complete cure must hardly be expected; the distressing symptom of fetor can, however, be relieved by the use of deodorising and disinfecting sprays, and the sense of dryness by the internal administration of salicylic acid and cubebs. The insufflation of a powder of salicylic acid 1 part, gum acacia 2 parts, will often take away the fetor in a few hours. Should the anterior part of the nasal cavities be also affected by the atrophic form of catarrh, the like remedies should be applied by the anterior nasal spray-producer; whilst, at night, Gottstein's nasal tampons should be inserted, or an iodoform and eucalyptus bougie be allowed to dissolve in each nasal chamber.

W. J. WALSHAM.

RETRO-PHARYNGEAL ABSCESS.

An abscess in the connective tissue between the pharynx and the spine.

Cause.—It may be seen at all ages, but is most frequent in children, occurring even in infants; in them it is often idiopathic. It is said to be more frequent in boys than in girls (Cohen). When idiopathic, a history

of tubercle or syphilis is generally obtainable. Most commonly it is due to spinal caries, and is then chronic (*see* CARIES OF THE SPINE); but may complicate quinsy, and follow acute pharyngitis, especially after the exanthems, acute phlegmonous sore-throat, erysipelas, and syphilis; this last even occasioning caries at the same time. Injury to the pharynx from food, hot liquids, irritants, foreign bodies—e.g. impacted false teeth—may cause abscess.

Pathology.—Predisposition to inflammation of this part exists in its lymphatic structure, its constant mobility, and its liability to injury and variations in temperature. When idiopathic, suppuration begins in the submucous adenoid tissue (Bókai); when it begins in the deeper connective tissue, it is likely to be tubercular (Cohen). Caries of the front part of any of the cervical vertebræ determines the presence of pus behind the pharynx, though it often burrows down and becomes post-mediastinal. Retro-pharyngeal abscess is usually on one side of the middle line, and is accompanied by induration that can be felt below the angle of the jaw on the same side. It may point in the mouth, or on the side of the neck, and has been known to follow the brachial nerves to the axilla. The presence of the abscess causes mechanical dyspnoea and dysphagia, and by bursting may flood the larynx and suffocate. When post-oesophageal, it may open into the lung or oesophagus. Other complications are oedema of the glottis, and opening into the internal carotid artery. Sequestra are often discharged by the mouth, when caries is the cause of the abscess.

Symptoms and Diagnosis.—When acute, there is general pyrexia, with local heat and tenderness, dysphagia, huskiness, stiffness in the neck, and dyspnoea which is relieved by the erect posture. When sleeping, the patient snores as in tonsillitis. As the abscess enlarges, the head is thrown more backwards, and a tender swelling appears at the angle of the jaw. The mouth is opened with difficulty, and there may be profuse secretion of mucus (as in oesophagitis), which must not be mistaken for salivation. A fluctuating and very tender and unilateral swelling will be seen or felt in the pharynx, and when in the nasopharynx it pushes down the soft palate. The more laterally placed, the less the dyspnoea and the greater the resemblance to quinsy.

The chronic form, due to caries, often gives rise to no symptoms until there is dysphagia or dyspnoea; possibly the swell-

ing at the angle of the jaw may first attract attention; or the abscess may have become post-mediastinal, and even have opened into a bronchus or the pleura before it is discovered. Excepting the accompaniments of acute inflammation, the condition is as detailed above; and, as manipulation is less painful, fluctuation between the external swelling and that in the pharynx may at times be made out. Left to Nature, the abscess may increase so as to necessitate interference, or it may burst in the mouth, in the chest, or externally; or it may sometimes resolve. Parts of the cervical vertebrae may come away through it. When symptoms of cervical caries are obscure and unnoticed, the abscess may never be recognised; sudden death has been known to occur from atlanto-axoid disease where it was unsuspected, and the autopsy alone revealed a post-pharyngeal abscess.

Diagnosis.—The acute form of abscess in children may be mistaken for croup; but the dyspnoea is relieved by sitting up, is very intermittent, and unaccompanied by the crowing noise of croup. Dysphagia is a prominent symptom, the child even declining to try to swallow. Inspection of the throat reveals the condition at once. The chronic form has to be distinguished also in children from sarcoma; this last grows rapidly, does not fluctuate, though it is soft, and its surface is nodular or irregular. See PHARYNX, Tumours of the.

Treatment.—Retro-pharyngeal abscess should be evacuated as soon as possible. The old method with trocar and canula through the mouth is for many reasons unsatisfactory. A vertical incision into the tumour, with a bistoury guarded up to its point with sticking-plaster, is easily made, but the left forefinger must hold down and push back the tongue at the same instant, so as to force the epiglottis over the laryngeal aperture, or the first gush of matter may enter the windpipe. When pointing, the finger-nail has been employed to open the abscess. As in other wounds made in the oral cavity, there is but little risk of septicæmia; yet, if desired, the abscess can be opened aseptically by dissecting down upon it behind the sterno-mastoid, and thrusting dressing-forceps into it. See ANTISEPTIC SURGERY. The simpler plan of opening it in the mouth has the advantage of easily allowing a sequestrum to be removed. The writer does not think the advantages of the external method commensurate with its difficulty of performance and more serious character.

C. HILTON GOLDING-BIRD.

RHEUMATOID ARTHRITIS. See CHRONIC RHEUMATIC ARTHRITIS; OSTEO-ARTHRITIS.

RHINOPLASTY.—Under this heading is included a number of plastic operations performed for repair of the nose, in cases of deformity and partial or total loss of that organ. The disfigurement requiring an operation of this kind may be the result of congenital malformation, of injury, or of surgical operation, but in most instances is due to syphilitic, tubercular (lupoid), or cancerous ulceration. The disfigurement, in severe cases of the latter class, is caused partly by destruction of more or less of the nose, and partly by contraction of cicatricial tissue. Although the most favourable conditions for the success of a plastic operation are presented by this region, still the results of rhinoplasty are not usually very satisfactory. The soft parts around the nose are very vascular and well-organised, and thick flaps composed of several layers of varied tissue may be brought over the defect from almost every quarter; but notwithstanding this, it too often happens that, as was pointed out by Denonvilliers, a repulsive deformity has been converted into one that is ridiculous. It has been asserted, however, that the loss of smell and taste, caused by complete destruction of the nose, may be overcome to some extent by supplying a new nose, and there can be no doubt that the patient is thus rendered less liable to attacks of laryngeal and bronchial catarrh. The appearance of a prothetic apparatus of some foreign material is no less unpleasant, especially during transient changes in the vascularity of the adjacent sound parts.

The results of a rhinoplastic operation, with regard to the relief of deformity, will depend much more on the extent of osseous than that of cutaneous loss. If the bones of the nose be preserved, there is always a good chance of restoring a prominent and sightly organ, though most of the skin may have been destroyed. In cases of destruction of the osseous framework of the nose, on the other hand, the surgeon cannot expect to do more than cover the open chasm by a flap, which will remain almost on a level with the cheeks. With regard to the condition of the soft parts, from which it is intended to take one or more flaps, mere superficial cicatrization would not interfere with the success of the operation. Indeed, scarred skin under certain circumstances, as in the restoration of an ala, would be more suitable material for a flap than skin that is quite sound. When, however, the skin around

the nose has been almost completely destroyed and converted into dense cicatricial tissue, as after a deep burn, the flap would shrink to a considerable extent, and very probably slough. The most unfavourable conditions for rhinoplasty are those in which the nose has been destroyed by syphilitic ulceration or a burn. In cases of destruction by lupoid or cancerous ulceration, by which usually only the soft parts of the organ are destroyed, the prospects of success are more promising.

It has been laid down as a strict rule that, before rhinoplasty be practised for deformity from specific ulceration, an interval of at least six months should follow the disappearance of all signs of active disease. The patient at the time of the operation should be quite healthy, and placed in the best possible hygienic conditions. The complications to be feared during the after-treatment are sloughing of the flap, renewal of the specific ulceration, secondary hæmorrhage, and erysipelas.

For restoration of a completely destroyed nose, the surgeon may transplant a flap from some distant part of the body, as in the old Tagliacotian or Italian operation, or transpose one from the forehead. The former procedure, which, as is well known, consisted in taking a flap of skin from the inner surface of the arm, had from the time of Dieffenbach remained obsolete and of simply historical interest until recently, when it was again performed with much success by Sir William MacCormac in a case of partial loss of the nose with cicatricial deformity of the face, and also by Mr. Hardie of Manchester, who took the flap from the flexor surface of the thumb. The flap has been taken also from the forearm. Though disfigurement of the forehead or cheeks will be thus prevented, the after-treatment in the Italian operation must always be attended with much difficulty, and be found extremely irksome and disagreeable by the patient. The skin of the arm is not so suitable for rhinoplasty as that of the forehead. The primary retraction is certainly very considerable, and, according to Dieffenbach, the subsequent atrophy also was greater in flaps derived from the former source.

In the Indian or frontal operation, performed most frequently by German and English surgeons, a large flap is taken from the forehead and twisted downwards on an inferior attached pedicle, so as to cover the defect. In the first stage of this operation, a commensurate model of the new nose is formed of stiff paper or cardboard, which is

then flattened out on the middle of the forehead. A flap of the same shape as the flattened model, but larger to the extent of a quarter of an inch in every direction, is next mapped out by a deep incision down to the pericranium, and dissected away until it is attached merely by a narrowed root near the internal canthus, on one or the other side. The broad base of this flap usually falls just within the region of the hairy scalp. The hæmorrhage from the large wound thus formed having been arrested, the edges of the defect are pared, except below near the lip, the whole thickness of the soft parts being divided. In this dissection the knife should be carried obliquely from without inwards, so as to cut away more of the deeper portion of the skin than of the surface, and to form a shelving wound around the nasal orifice. This is usually the second stage in the operation, but some surgeons commence by refreshing the edges of the defect, and afterwards take up the frontal flap.

In the third stage, the triangular flap, still attached by its pedicle, is twisted outwards, and then brought downwards, over the defect, to the pared margins, to which its edges are fixed by sutures. The edges of the large wound in the forehead are next approximated by needles and twisted sutures. The columna of the new nose may be formed, either by a narrow process of skin extending from the broad base of the frontal flap, or by a separate tongue-like process cut from the middle of the upper lip, and turned upwards to be fixed by its free end to the tip of the new nose, whilst the other extremity remains attached near the lower margin of the nasal orifice. The lower edge and the alæ of the new nose are elevated at first by pieces of lint, and afterwards, during the healing process, by metal or 'gum-elastic' tubes. The seat of operation should be covered by some simple dressing, and over this a thick layer of cotton-wool. After an interval of six weeks, when the circulation in the new nose has been established, and œdema and signs of congestion have disappeared, the pedicle may be divided, and some small plastic operation be performed for relieving the deformity caused by its prominence.

The best material for the sutures used in this operation for fixing the flap is fine silver wire. Silk often causes some slight sloughing around the punctures, and catgut soon becomes soft, and either melts or gives way. The use of stout needles, with the object of elevating the flap, is liable to

cause too much traction on the tissues around the defect, and also to interfere with the circulation in the new nose.

The chief source of failure in this operation is obstruction to the blood-supply of the transposed frontal flap, through torsion of the pedicle. With the view of reducing this torsion as far as possible, many modifications have been proposed in the position of the pedicle and also of the flap. Lisfranc held that one of the incisions limiting the pedicle should be carried half an inch lower than the other, so as to reach almost to the upper margin of the defect; whilst Langenbeck forms the pedicle to one side of the median line, and commences the two incisions just above the internal canthus. Other German surgeons carry the outline of the whole flap more or less obliquely across one side of the forehead, and, in extreme forms of this modification, the long axis of the flap is almost parallel to the line of the eyebrow.

The inclusion of periosteum in the frontal flap, as practised by Langenbeck and Ollier, with the object of rendering the new nose more prominent, does not seem to have been followed by very good results; and, as was pointed out by Serre of Montpellier, might excite inflammatory mischief in the frontal bone, and even give rise to some encephalic complication.

Ollier has endeavoured to impart a good shape to the new nose formed by a frontal flap, by transplanting, in connection with this flap, one of the nasal bones; and instances have been recorded in which Hardie of Manchester, and Sabine, an American surgeon, practised the Italian method, and transplanted the last phalanx of the forefinger.

Rhinoplasty by transposition of lateral or facial flaps—a method to which much attention has been paid by French surgeons—will be found suitable in cases in which the upper part of the nose remains intact. This plan of operation, which is a very old one, and was described by Celsus, has of late years undergone a great variety of modifications. Its simplest form is presented by the operation practised by Syme, which consists in taking two flaps of skin from the cheeks, uniting these in the middle of the face by three or four sutures, and then fixing the outer edges on each side to the raw surface, at a proper distance from the nasal orifice. The wounds of the cheek admit of being nearly closed by a stitch through the edges of each, and what remains of them is of use by the contraction of the granulating process depressing

the hollow at the side of the nose, and thus increasing its apparent elevation.

In Nélaton's operation, two thick flaps, each with a pedicle attached near the lacrymal sac, are brought downwards and inwards over the defect, and stitched together in the median line. In making these flaps, the periosteum is removed from the nasal process of the maxillary bone, so that the resulting scar may be dense and closely attached to the bone, and so rendered incapable of dragging on the new nose. A further attempt to prevent flattening of the organ is made by passing a stout needle through both alæ, and compressing these by the action of a weak metallic spring. In the many modifications of this method, the shape and direction of the flaps are much varied. In some cases, the soft parts of the face have been simply glided over the defect after free separation from the subjacent bone. The chief objections to the so-called French method of lateral flaps are the severe primary hæmorrhage, the risk of secondary hæmorrhage, the disfigurement caused by a linear cicatrix in the middle line of the new nose, and the tendency in the organ to become flattened through tension of the soft parts of the cheek.

A combined frontal and facial rhinoplastic operation, first proposed by Verneuil and practised in this country by Mr. F. Mason, consists in turning down over the defect a frontal flap with its raw surface outwards, and covering this by two flaps taken from the cheeks.

In 1867 Mr. John Wood reported a case, in which he had formed a new nose by taking a broad flap from the upper lip. This, after it had been elongated by separation of the cutaneous and mucous layers extending as far as, but not through, the border of the lip, was turned upwards and fixed by sutures to the upper margin of the nasal defect, and, finally, its anterior raw surface was covered by lateral flaps taken from the cheeks.

In cases where but one or both alæ have been removed by injury or ulceration, a flap may be taken from the sound portion of the nose. Where one ala has been removed, the flap is usually taken from the opposite side, and where the end of the nose has been destroyed on both sides, a square flap has been taken from the bridge and turned downwards, with the epidermic surface directed towards the nasal cavity. In cases of this kind, a flap may be taken from the upper lip or even, as proposed by Michon, from the mucous membrane of the nasal septum. Almost innumerable modi-

fications of the rhinoplastic operation by nasal flaps have been devised by Dieffenbach, Langenbeck, Denonvilliers, Busch, and others.

When the nose has been partially removed by injury or surgical operation, immediate rhinoplasty is not, as a rule, indicated. According to Verneuil, in cases of removal of a portion of the skin without perforation of the cartilage, in which the loss is not excessive, the surgeon should leave the wound to heal by granulation, and not attempt immediate union or cover it by a cutaneous flap.

Several operations have been devised for the relief of the disfigurement caused, in cases of destruction of the bony framework only, by depression and flattening of the soft parts of the nose. The aim, in most of these procedures, is to raise and approximate the two wings of the nose after vertical incision of the organ itself, as in Dieffenbach's method, or after extensive separation of the attached margins of the organ and of the soft parts of the cheeks from the subjacent bone, as in the modification devised by Sir William Fergusson. In the latter operation, the alæ having been separated from the parts beneath, and the knife carried on each side between the skin and the bone as far as the infra-orbital foramen, two long needles were passed through the nose from one cheek to the other, and their ends twisted over a small piece of leather applied on each side, so as to cause the cheeks to come closer to each other, and thus render the nose prominent.

In cases of abnormal shortening of the nose from imperfect development, Weir of New York proposes to make a free incision in the soft parts across the middle of the organ, and then, after drawing down the lower part, to fill up the large gap thus formed by flaps taken from the cheeks.

W. JOHNSON SMITH.

RHINOSCOPY.—Inspection of the nose—rhinoscopy—may be practised from the front (anterior rhinoscopy), or from behind (posterior rhinoscopy). For both methods of examination, to make them successful and complete, good illumination and gentle handling of the instruments are essential, even more so than in laryngoscopy.

ANTERIOR RHINOSCOPY.—To obtain a good view of the anterior parts of the nose, direct or reflected rays of light must be thrown into the patient's nose in the manner described in the article on **LARYNGOSCOPY**. The relative positions of the surgeon, the patient, and the source of light,

and the methods for illuminating the parts, are identical with those described in that article. Dilatation of the nostrils is necessary for complete examination of all the parts accessible to inspection, and to effect this, innumerable nasal specula have been invented. The writer has found B. Fränkel's fenestrated instrument, and the longer variety of Duplay's cone-shaped bivalve speculum, both of which are provided with a screw arrangement to open the blades, most serviceable, and, indeed, sufficient for all ordinary purposes. The former is especially useful for examination of the anterior and lower, the latter for inspection of the upper and posterior parts of the nose. The patient's head being slightly inclined backwards, the speculum is to be gently introduced into one of the nostrils (which must have been well cleaned previously); its blades are to be opened, by turning the screw to as full an extent as possible without hurting the patient, and light is then thrown into the cavity, either directly, or from the frontal mirror attached to the surgeon's forehead. When a sufficient view has been obtained of the parts which are immediately in sight, the operator, whilst retaining the speculum with one hand in the nostril, places his free hand on the patient's vertex, and by gentle pressure causes him to bend his head in any desired direction, slightly downwards, upwards, to the right and to the left, the inspection being continued meanwhile. This is necessary in order to obtain a view of all that is really visible, and it is more advisable to direct the movements of the patient's head by touch than by words, in order that the movements may not be too sudden or too violent. After completing the inspection of one nostril, the other is examined in the same manner.

The appearances vary very considerably in different cases. The larger part of the septum, which but rarely appears as a thoroughly straight vertical plate and is more frequently deflected into one or even both nostrils, can be satisfactorily brought into view. The colour of its mucous membrane is, usually, yellowish-red. The lower turbinate bone, which is the most conspicuous object after introduction of the speculum, appears as a bright red, oval or nearly semi-globular bulging, the floor of the nose as a rather flat or slightly excavated groove. The anterior part of the middle turbinate bone can mostly, but not always, be brought into view by the patient bending his head slightly backwards, and in exceptional cases a small part of the

upper turbinate bone may be seen. In cases of *ozæna*, when considerable atrophy of the lower turbinate bones has taken place, it is often possible to look through the nose into the naso-pharyngeal cavity, and to observe the play of the tubal muscles. Professor Zaufal has lately devised long funnel-shaped nasal specula, which are intended to render such inspection, as well as examination of the posterior parts of the nose and certain operations, possible in all cases.

The frequent irregularities of the configuration of the interior of the nose, the physiological deviation of the septum, the common occurrence of exostoses, &c., often make it rather difficult for the beginner to correctly interpret what he sees. Practice alone can lead to more precise information. Examination by means of the blunt nasal probe, under the guidance of the eye, ought under all circumstances to complete the results of mere inspection.

POSTERIOR RHINOSCOPY is an excellent, though not always applicable, adjunct to digital exploration of the naso-pharyngeal cavity. Its method consists in the introduction into the patient's mouth and behind the soft palate of a small laryngeal, or, as it is called here, rhinoscopic mirror, with the reflecting surface upwards, when, after proper illumination of the mirror, a reflected image of the parts above will appear on its surface. Simple as this proceeding appears to be, it is in reality sometimes very difficult. Much depends upon the co-operation of the patient, and this is not always easy to obtain. The better educated and less nervous the patient, and the larger his pharynx in its antero-posterior diameter, the more easy will be the examination. The main difficulties dependent upon the patient are threefold—(a) involuntary retraction of the velum towards the posterior wall of the pharynx (usually associated with too forcible an opening of the mouth and faulty breathing, or involuntary arrest of respiration); (b) refractoriness of the tongue, the middle and posterior parts of which constantly arch upwards; (c) excessive irritability of the palate, uvula, and posterior wall of the pharynx, causing spasmodic contraction and retching, so soon as these parts are, however lightly, touched. Previous local application of a strong cocaine solution—the writer uses by preference a 20 per cent. solution—will entirely overcome the last-named difficulty. With some practice and patience, however, such application will generally be superfluous. It is essential to teach the

patient to breathe as quietly and naturally as possible *through the nose*, the object of this being that the soft palate should be entirely relaxed. This is indispensable for the success of the examination. A great many palate-hooks, uvula-nooses, and elastic tractors have been invented, with the object of forcibly drawing the soft palate forward, and thus laying the naso-pharyngeal cavity open to inspection. In some very tolerant individuals they may be useful; in almost every case, however, in which posterior rhinoscopy is at all possible, more will be obtained by patience, gentleness, and repetition of the examination, than by artificial means.

The relative positions of the patient, the surgeon, and the source of light are the same as in laryngoscopy. The patient is told to open his mouth, to keep his tongue in, and to breathe quietly through his nose; forcible respiration is as much to be deprecated as holding of the breath. The surgeon now introduces the warmed rhinoscopic mirror, the reflecting surface of which (not more than about five-eighths of an inch in diameter), is directed upwards to the right or left side of the uvula, into the pharyngeal cavity proper. He must guard carefully against touching the posterior part of the tongue, the velum palati, the palatine arches, and the posterior wall of the pharynx. Instead of a small laryngeal mirror, Michel's rhinoscope may be used. In this instrument, the angle of the mirror to the shank can be changed to any desired extent by a spring in the handle, while the shank remains perfectly immobile. The light is thrown on the rhinoscope from the frontal mirror or other source of illumination. The writer's electric rhinoscope (see *Lancet*, March, 1885) dispenses with the difficulty of the last-named proceeding. If a laryngeal mirror be used, its shank will usually answer as a tongue-depressor, but, in some cases, it will be better to gently but firmly depress the tongue with a spatula held in the operator's left hand, whilst his right hand directs the rhinoscope.

A complete inspection of the naso-pharyngeal cavity can only be made by altering the position and slanting the mirror, the rhinoscopic image being a compound picture. It will often be necessary to introduce the mirror several times, before this purpose is achieved.

When the mirror is held more in the vertical position, the choanæ, or posterior nares, come into view. The posterior aspect of the nose shows in its middle the septum, forming a thin, straight, almost white pro-

jection, which above passes over, in the form of two symmetrical Roman arches, into the vault of the pharynx. It is of practical importance to know that these arches are visible in every normal rhinoscopic image; should they not be seen, this proves that they must be obscured by some abnormally developed tissue. On both sides of the septum the posterior ends of the three turbinate bones appear, the middle bone being the most conspicuous. Their configuration is somewhat variable; the superior turbinate bones are rather horn-shaped, the middle oblong, the lower rounded. Their colour, on the whole, is pale, especially that of the middle turbinate bones. Between them are visible, more or less distinctly, the three nasal meatuses. When the mirror is held in a more horizontal position, the vault of the pharynx comes into view. Its appearance is often rather irregular and rough, owing to the adenoid tissue by which it is covered. On slanting the mirror, held at an angle of about 130° to the horizon, and inclined towards one side, the internal opening of the Eustachian tube, with its folds of mucous membrane, and Rosenmüller's fossa come into view. Below and in front, the upper surface of the velum, in the middle of which the so-called 'uvula cushion' is visible, forms the lower border of the rhinoscopic image. FELIX SEMON.

RIBS, Fractures of the.—These are among the most frequent of all bone-injuries, forming about a tenth of all the fractures we are called on to treat. They are more common in the male than in the female, on account of the greater exposure of the male sex to violence; more frequent in the middle-aged and old than in young people, on account of the greater elasticity and softness of the bones in the young; and they occur more often about the seven upper ribs than in the five lower, on account of the more rigid way in which these ribs are connected to the sternum. In children, the fracture is very often incomplete from the way in which the rib is driven inwards; in such cases, the part of the rib towards the pleura may be fractured, while the outer part remains intact. In this way, damage to the pleura may sometimes arise, while the rib remains apparently intact.

The ribs are most commonly fractured by the application of some strongly compressing force. When the force is applied over a small surface, the fracture is said to be by direct violence, as takes place when a rib is fractured by the blow of a rope's end, or

of a fist, or when the body falls upon some projecting point. When the force is applied over an extensive surface, as when the ribs are fractured by a wheel passing over the chest, which thus caves in, the fracture is said to be by indirect violence, the rib in this case fracturing at a distance from the point where the violence is actually applied. The distinction is only of importance in relation to the number of ribs fractured. In fractures produced by indirect violence, the number is likely to be much greater than when produced by direct violence. On the other hand, direct violence is apt to drive the end of a single rib further into the cavity of the thorax, and thus is more likely to damage the thoracic viscera. Fractures of the ribs are also produced by muscular action, as in the act of coughing or sneezing. It is possible that some of the apparently spontaneous rib-fractures of old people are produced in this way.

The number of ribs fractured depends very much upon the nature of the injury. In fracture produced by direct violence, only one side of the body is generally affected; in those produced by indirect violence, one or both sides may be affected, and a rib may even be broken in two places. Fractures of the ribs are scarcely ever compound, except from gun-shot injury.

The *symptoms* of a fractured rib are often rather indefinite. There is pain at the seat of fracture, undue mobility, detected principally by pressure upon the end of the rib, and crepitus, which is often difficult to detect, but which is best done by placing the hand over the chest and making the patient breathe. In this act, a little alternate pressure and relaxation of the hand will often make the crepitus apparent, when it is otherwise difficult to make out; or it may be detected by placing the ear or stethoscope to the chest, and causing the patient to take a full inspiration. Difficulty in breathing and coughing, and more or less 'stitch in the side,' are also commonly present. The respiration is mostly diaphragmatic. The cough is very peculiar; it is slight and suppressed but frequent, and troublesome from the pain caused by it. This pain is probably due to some irritation of the intercostal nerve at the seat of fracture.

Fracture of the ribs is often complicated by damage to the internal viscera. The pleura is the part most frequently injured, and after this the lung. But many other parts are also occasionally damaged. Thus, a case is on record in which a single rib

was fractured by the end of a rope flying loose. The fractured piece was driven in through the pericardium and pierced the apex of the heart, causing almost immediate death. The diaphragm and liver are not infrequently damaged by fractures of the lower ribs, the spleen less frequently so, unless enlarged into an 'ague-cake,' while fractures of the eleventh and twelfth ribs may rupture either the ascending or descending colon. Injuries to the pleura and lung give rise to hæmothorax and emphysema, more or less general. See EMPHYSEMA; HÆMOTHORAX; LUNG, Wounds of the; PERICARDIUM, Wounds of the, &c.

Treatment.—The object of the treatment should be to immobilise the fractured ribs, so as to put them in the most favourable state for repair. This is best done by fixing broad bands of adhesive strapping (about two inches wide) from the sternum to the spine. These bands should overlap freely, so that a fair *thickness* of plaster be formed, thus acting as a kind of splint to the side of the chest, causing it all to move together in the act of respiration. If many ribs are fractured, and it is desirable to form a more solid splint or mask for the side of the chest, one or two thin pieces of light wood may be placed outside this strapping at right angles to the course of the ribs, and united to the layer of strapping beneath by other layers laid on superficially to them. This aids in making the whole side of the chest move as one piece, and is especially useful, combined with pads, where the fracture is depressed, and it is thought desirable to attempt to lift the depressed ends out of the chest. Some surgeons prefer to put a single piece of strapping over the whole of the side of the chest. This, however, never fits to the surface as well as the strips, and, if more thicknesses than one are considered desirable, it cannot be laid on so uniformly. Some surgeons, again, prefer to make the strips of plaster surround the whole chest, and some apply a bandage moderately tightly round the chest, even in cases where only one side is injured. This plan has the disadvantage of limiting the movements of both sides of the chest, whereas it is for the comfort of the patient to leave the respiratory movements of the uninjured side as free as possible.

The use of the bandage, though common, is in some cases not absolutely free from risk. Flannel is usually chosen, as being more suitable from its slightly elastic texture. But the writer has seen more than one case in which this rather elastic bandage, from being too tightly applied, has so

compressed the chest that it has caused the fractured ends of the ribs to be driven in, so that they wounded the pleura and the lung. An elastic bandage then should be applied with only very moderate pressure, and may generally be dispensed with altogether. The sensations of the patient may, however, be taken as the best test of its utility. If grateful to him, it is certain it is doing no harm, and may be continued; but if it causes oppression and pain it should at once be taken off. Indeed, some patients cannot bear anything upon the chest, and prefer simply to lie motionless in bed. Other methods of treatment have been used—as, for example, a kind of vest made to fit the body very closely, and to be suspended from the shoulder. This, however, is not so efficient as the plaster method.

Constitutional treatment will be necessary in many cases, where the patient is irritable or suffers much pain. An uncomplicated case of fracture will not generally require anything, but if it be complicated by any damage to the pleura or lung, it may be necessary to give small doses of sedatives, combined with expectorants and diaphoretics. Of these, the following is a most useful combination:—℞ Tinct. scillæ, ℥v.; Vin. ipecac., ℥v.; Tinct. camph. co., ℥xx.; Vin. antimonial., ℥x.; Liq. ammon. acet., fʒss.; Aq. chlorof. ad fʒj. M. Ft. haust. 2ndis horis sumendus.

If the fracture occur in very old people suffering from chronic bronchitic conditions, more stimulant expectorants are required, and carbonate of ammonia (gr. v. doses) with infusion of senega (fʒss. doses) may be substituted for the squill and acetate of ammonia. In such cases, putting the patient into a steam tent is often a very great relief to him. Where there is evidence of much intra-thoracic inflammation in younger persons, leeches may sometimes be advantageously applied to the chest, and even the advisability of venesection be considered. This method of treatment has almost disappeared from practice of late years, but the writer has seen some few cases in which the patient was in a state of great distress, with considerable dyspnoea, oppressed pulse, and much blueness and congestion of the face, in which a moderate venesection most markedly relieved the symptoms.

The *prognosis* in uncomplicated cases of rib-fracture is very favourable. The fracture nearly always unites by bony union, but often a considerable amount of callus is formed, from the necessary mobility due to the act of respiration. Sometimes a case

of non-union will occur, with possibly abscess and necrosis. Such cases generally indicate some predisposing constitutional condition. The prognosis is least favourable in old bronchitic persons. In these patients, a considerable secretion of mucus normally goes on from the bronchial tubes, and this is expectorated by frequent fits of coughing. After a fracture of the ribs, the pain on movement causes the cough to become suppressed, the expectoration of the mucus no longer takes place, and thus accumulation goes on to such an extent as to choke the smaller tubes and lead to death by apnoea. In fractures of the ribs, complicated by injuries to the internal organs, the prognosis depends upon the organ injured. If the diagnosis be doubtful at first, it is safer, for purposes of treatment, to assume that the major injury has occurred, and to treat the patient accordingly, until the diagnosis has become clear from the after-history of the patient. Emphysema occurring after a fracture is not generally an unfavourable sign; it quickly absorbs if left to itself. H. G. HOWSE.

RICKETS may be defined as a constitutional dyscrasia resulting from general malnutrition. It is peculiar to infancy (perhaps to the fetus) as regards its initiatory stages; and, in its later ones, chiefly characterised by changes in the texture, chemical composition, and outward form of the bony skeleton, and by altered function in other organs, transient for the most part, but occasionally permanent. Although the disease has been carefully studied in all its stages, the earliest beginnings are still quite matters of conjecture. Rickets is said to occur 'in every quarter of the globe' (Senator.) The writer has himself seen it in almost every European capital, and in the South African colonies, where the summer lasts nine months, and where overcrowding, fogs, and deficient sunlight are quite unknown. It is especially common among the manufacturing population of Yorkshire and Lancashire; it is found at places on the sea coast, as well as inland. There can, however, be no doubt that rickets is chiefly a disease of large cities, and that its development is favoured by overcrowding, neglect of sanitary and hygienic precautions, and by a cold damp atmosphere, which compels people to shut themselves up in ill-ventilated habitations.

Guérin, Storch, and especially Bednär and Ritter, admit *hereditary influences* in its production, and regard the occurrence of congenital rickets as an argument *ad hoc*.

The writer has seen many cases of direct transmission from parents to children, and at least one case of transmission from the grandparents. The disease, nevertheless, is not generally allowed by clinical teachers in this country to be hereditary. Of 1,000 children under three years of age, including babies in arms, examined in the out-patient department of the East London Children's Hospital—many of whom did not come as patients but simply accompanied their mothers—800 at least bore some traces of rickets; many of these were brought on account of pronounced rickets, but in many others the diathesis showed itself in its less generally acknowledged forms—enlargement of radial epiphyses, slight beading of ribs, late closure of fontanelles, or general backwardness. These children—boys and girls—brought up under conditions (to be presently described) which favour the development of rickets, will grow up, and in due time intermarry. Their children, bred and born under like circumstances, must surely inherit a stronger predisposition to the diathesis than the children of other persons, not so affected in their youth. The growing frequency of the milder forms, and their appearance under surroundings not usually associated with rickets, are only to be explained by this hereditary influence. Jenner 'has no facts to prove that rickets is hereditary'; but, like other authorities, admits that all those conditions which deteriorate the health of the parents, of the mother especially, render the children liable to rickets. Thus, frequent pregnancies, disparity of years in either spouse, advancing years, late marriages, irregular habits of life, acute illnesses, chronic disease (scrofulosis, tuberculosis), inherited syphilis, starvation in the parents—each and all exercise deleterious influences on development of the offspring, which predispose them to rickets. Thus, it is obvious why the poor should not alone suffer from this diathesis; on the contrary, rickets is found among all classes of society, although the advanced and fatal forms are most common among the poor.

The influence of heredity, however, is further proved by the frequency with which many members of the same family suffer, even without the immediate influence of that environment which is known to develop rickets. The absence of any persistent symptoms in the parents is no argument against this view, any more than it would be in the case of gout, or rheumatism, or other disease, the manifestations of which are temporary and generally fleeting.

Period of Onset.—Some of the signs of rickets are not infrequently found in foetuses (a condition, however, not to be confounded with *foetal rickets*, which will be briefly considered further on), and still more frequently in children at birth. These signs consist in curvatures of the long bones, with enlargement of their epiphyses; beading of the sternal ends of the ribs, with a tendency to pigeon-breast; an unduly open condition of the fontanelles and sutures, with enlargement of the head. More marked and more generally acknowledged signs have been observed a few weeks later; thus, Gee says: 'Unquestionably beading of the ribs may occasionally be found in infants of only three or four weeks old; at three or four months of age rickets is quite common.' Ritter has described extensive beading of the ribs in an infant of three weeks; Virchow, at five weeks of age. Moreover, he refers to the specimen of a rickety foetus in the Berlin museum. Hensch also records having seen two children, who were born 'with multiple incurvations and inflexions' of the bones, and with great softening of the entire skullcap. The writer has examined foetuses with unmistakable signs of rickets, and seen many cases, with well-marked symptoms, in infants of one month and upwards.

When it is considered that one of the earliest signs of rickets—enlargement of the epiphyses, according to some authorities the only pathognomonic sign—is not regarded as disease even by the profession, and that children so affected are not generally brought under treatment, it is not surprising that the published statistics show only about four per cent. of rickets in infants under and about three months of age. A recent analysis, by the writer, of one thousand consecutive cases gave the following particulars as to the asserted period of onset of rickets as usually understood. During—

			Per cent.
1st year	1st six months	202	20.2
	2nd six months	278	27.8
2nd year	3rd six months	238	23.8
	4th six months	144	14.4
3rd year	.	98	9.8
4th year	.	18	1.8
5th year	.	14	1.4
6th year	.	8	.8

The above figures show how great is the incidence of the disease during the earlier months of life, and they suggest a far-reaching and fairly uniform cause, such as congenital predisposition—heredity—to account for it.

Causes.—Enough has already been said to show how largely the constitutional element, in the writer's opinion, enters into the question of causation. Many authorities, on the contrary, regard *artificial feeding* as the chief, not to say sole, cause of rickets. This latter view, however, is very misleading, and leaves out of consideration those factors which are most potent; improper diet, however, is unquestionably a very powerful cause, and it is most likely to lead to rickets in children who are weakly and delicate from birth. That many children who are carefully suckled and brought up, suffer from the early phases of rickets, is a fact beyond dispute, and that many escape who are fed artificially, and indeed never thrive until so fed, is equally true; we must, therefore, be very chary in attributing rickets to errors in diet alone. Moreover, when several children in a family, one after the other, become rickety, the recognition that this depends on debility in the parents at once suggests prophylactic measures which will save much trouble, and greatly increase a future child's chances of recovery, or even its complete escape from the affection. The particular kind of food which is considered so detrimental to these children is that which contains *starch*—that is to say, all *farinaceous food*. It has been found experimentally, but on an extremely small scale, that neither the saliva nor the pancreatic or enteric juices of young infants (and of many animals) can digest starch—that is, convert it into glucose; hence the inference that the administration of starchy foods to infants is the efficient cause of rickets.

There can be no manner of doubt that many children, who are carefully suckled, get rickets even in its pronounced forms, and as little doubt that many children, who are artificially fed, escape. *Protracted suckling* is a not infrequent source of rickets, and is detrimental alike to mother and child. Indeed, the inducement in very many cases to begin artificial feeding is either (1) a deficiency in the maternal milk-supply, itself not seldom an indication of weakly health; or (2) because the child does not appear to thrive on the breast-milk—in other words, because the child already begins to manifest signs of a deficient assimilative power which is congenital with it. That rickets should begin, in the majority of these cases, so early after artificial feeding has been commenced, suggests a strong predisposition thereto; for it is hardly conceivable that such food as

is usually given to these infants—cow's milk or cooked flour in some shape or other—should be able to produce the universal and often profound changes, throughout the entire skeleton, which are found in infants of quite tender age. The amount of unaltered starch contained in a couple of nursery biscuits, or in a teaspoonful of baked flour, oatmeal, arrowroot, or cornflour, made into pap as given to children, is ridiculously small; and it is begging the question to attempt to explain such a widespread disorder on the hypothesis that this starch, one of the blandest and most universally distributed substances in nature, is the *fons et origo mali*! A large percentage of all the children in whom the osseous system is only, or chiefly, affected appear to be well nourished. 'Only thirty per cent. are really ill nourished' (Baxter). When it is remembered that animals fed on starchy diet die of inanition, it must be confessed that the starch theory of causation has yet to be proved. Of great moment, however, are the privation of fresh air and sunlight, and the influence of unhygienic surroundings during the earliest months of life. Ill-ventilated, overcrowded rooms, the re-breathing of expired air, want of cleanliness, are among the most efficient causes of rickets, even in cases where the predisposition thereto is not very marked.

It has been asserted that rickets is a worn-out syphilitic affection, but there is absolutely no truth in the statement. *Syphilis*—like *scrofula* or like *tuberculosis*—is a factor only so far as it deteriorates the general health of the parents, and so renders their offspring weakly and more receptive to any unhygienic influences to which they may be exposed. Thus, rickets is a disease not due to any one cause, but brought about by many acting in concert. It is largely the outcome of civilisation, which tends more and more to aggregate the population, and thereby to enforce that neglect of personal health in adults, which reproduces itself in the children (among other ways) as rickets. It must be borne in mind that other diatheses may be associated with rickets in the same subject. Thus, syphilis and rickets are constantly seen allied, as also rickets and tuberculosis and scrofula. The recognition of these facts is chiefly of interest in regard to treatment.

Pathological Anatomy.—Glisson and almost all subsequent authorities have drawn attention to the frequent association of pallor of skin, flabbiness of muscles, and special liability to pulmonary and to gastrointestinal catarrh with rickets of the bones,

as indicative of a general disease. Nevertheless, possibly because these lesions cannot be said to be special, pathological attention has been chiefly directed to the changes which occur in the skeleton; and yet, the former are by far the most frequent causes of death. When the osseous system is alone or chiefly affected, rickets seldom proves dangerous to life. Some or all of the following lesions may be found *post mortem*.

Viscera.—The *lungs* are often found emphysematous along their margins, with extensive patches of collapse in their interior; the bronchial tubes are full of frothy mucus, the presence of which, by impeding the entrance of air, leads to the collapse. On section, the adjoining lung-substance may or may not show bronchopneumonic changes. Not infrequently, on their surface may be seen signs of pressure from the depressed ribs: in a few cases, the beading of the ribs (generally most marked on the inner surface) produces a series of depressions, where they have pressed upon the lungs. The *stomach* is generally distended, pale, and bloodless; its mucous membrane is thin, soft, and readily breaks down under the finger; there are often local patches of congestion, with abraded surface in some cases, and tenacious mucus adhering to them. The *intestines* are also thinned and pale; they generally contain undigested food and flatus, as evidence of their want of power and tone; the solitary glands and Peyer's patches are often prominent and congested. The *liver* is sometimes enlarged, now and again the capsule is thick and whitish, and the substance firmer than usual; it is, however, more frequently fatty. The surface may be indented, where the beaded ribs have pressed upon it. The *spleen* is more frequently affected, being larger, heavier, and firmer than usual: this is apparently due to a greater or lesser degree of hyperplasia of the connective tissue. There is no reaction with iodine. Occasionally 'white patches' are found on its capsule. It must be stated, however, that changes in the abdominal organs are comparatively rare in the post-mortem room, and that children may suffer severely from rickets in whom no such or other visceral changes can be found.

Nervous system.—Although rickety children are unusually prone to nervous disorders, no pathological changes, except perhaps a slight increase in the cortical white matter in some cases, have as yet been discovered to account for them; in a few cases, the brain-substance is softer, and the ven-

tricles contain more fluid than normal; whether this is the result of a chronic change—part of a general catarrh—or is merely a compensatory transudation, it is impossible to say. There is no abnormal change in the *heart or vascular system*. 'White patches' are very common in children whose chests are deformed from rickets (Wilks); and appear due to friction against ribs projecting inwards: the 'chosen seat' (Jenner) is on the left ventricle, a little above its apex; the heart-muscle examined in a severe case, fatal from gastro-intestinal and pulmonary catarrh, showed no appreciable deviation from the normal. The writer, in conjunction with Mr. Shattock, examined the blood in nine living cases of rather severe rickets. In eight of the cases the number of the red corpuscles was in excess of the standard, in one case as much as '24; in the ninth case the number was reduced, as from 5 to 3; this blood, when drawn, looked very thin and 'hydræmic.' In most of the cases, the discs varied considerably in size and in shape, some being thorn-apple and some crenate; nor was anything, not found in healthy blood, observed. There were no nucleated discs. The granule-masses observed likewise presented nothing remarkable: the colourless corpuscles varied in size as in health; in one case only was there any excess. This negative result is not without interest, in a disease which affects the bones so profoundly, in view of the part which the marrow of bones is said to take in the formation of the blood. It is difficult to say how far any of the foregoing visceral lesions are specific, or whether they are merely accidental complications; their frequent association, however, suggests that they form an integral part of the disease. The occurrence or absence of one or other symptom is only in keeping with the clinical experience, that a general disease may occasionally show itself in one tissue more severely than in another.

Osseous system:—Although variable in amount and at different stages of the disorder, the condition of the bones, especially at the epiphyseal junctions, both to the naked eye and under the microscope, is the only one which is constantly present and at all pathognomonic of rickets. The *chemical composition* of the bones presents some striking deviations from the normal, the causation and significance of which, however, are differently interpreted by different authors; analyses of other tissues, with a view to establish whether they too present any variations from the normal,

will have to be made on a large scale, before it can be settled whether the changes found in rickety bones are the essence or the consequence of the disease. Friedleben's admirable researches show that the metabolic processes are particularly active in the osseous system of *all* infants during the second half-year of life; and that the chief chemical changes consist in an increase of the organic elements and a diminution of the earthy salts. This is just the period at which also some of the most characteristic of the so-called rickety changes occur, these latter changes being almost identical in kind, but greater in degree. According to this author's observations, the general chemical characters of rickety bones may be thus summarised: diminished quantity of the earthy salts, most marked when the disease is at its height, nearer the normal in the older bone layers, far below normal in the newly-formed (osteoid) parts, and in the latter an increase in the carbonic acid; little difference in the amount of fat, with the exception of the long bones, where it is increased in quantity by the marrow contained in the spongy parts, and in the enlarged medullary canals. The specific weight is lessened in proportion to the extent of the affection. The organic framework undergoes no obvious change, but the unossified cartilage contains more water. The grosser changes consist in peculiar and characteristic alterations in shape, and sometimes in consistence; all the bones, or only some few, may partake in the changes. The flat bones appear to suffer markedly.

In the *skull*, a condition termed *cranio-tabes*, first described by Elsässer, is frequently found to exist. The cranial vault becomes so thin and soft that it yields to the pressure of the finger; sometimes the bone is no thicker than parchment, and crackles when pressed upon. This condition may be confined to small areas, or involve the greater part of the parietal and upper part of the occipital bones, being generally found most marked in the posterior segment of the skull. In the healthy condition, even at birth, the cranial bones although very thin are nevertheless quite firm, and capable of resisting great pressure. See CRANIO-TABES. Elsässer distinguishes this softening from actual perforations (which are congenital defects), and from similar conditions associated with hydrocephalus, cephal-hæmatoma, inflammatory changes, and the like. Though found in other diseases, there can be no doubt that cranio-tabes is a sign of rickets *par excellence*: it is rarely found

after the twelfth, and occurs most frequently between the third and fifth months. In other cases, the cranial bones are much thickened owing to proliferation beneath the pericranium; unlike thickening of the long bones, which is more or less uniform, this occurs in patches or along the margins. The thickening may be very considerable and very localised: it differs from healthy bone in being soft and porous. At the sutures and fontanelles, which are the equivalents of the epiphyses, ossification goes on very irregularly; the sutures often become much thickened and sometimes project beyond the level of the adjoining bones. The interior of the skull-bones does not present any abnormal change; the dura mater is always very adherent.

The *scapulae* and *pelvis* are hypervascular, coarsely porous like pumice-stone on the surface, but possess a central, thin, firmer layer of normal bone; this outer deposit may have a distinct lamellar construction, and contains more marrow and less earthy salts than normal cancellated bone. Along their margins the bones are much thickened. The pelvic bones, from their position and the weight which is transmitted through them, often undergo important deformations, the permanent effects of which, in adult women, may interfere seriously with child-bearing. The *clavicles* become acutely bent (a condition which may be easily mistaken for fracture) just outside the attachment of the sterno-mastoid and pectoral muscles. The *ribs* often suffer greatly; normally they are more vascular than the other long bones, and are long in proportion to their size. Virchow teaches that the predisposition of certain bones to manifest rachitic changes stands in direct relation to their physiological use. It will be conceded that the ribs are constantly in use. There are two spots at which rickets manifests itself chiefly—viz. between the tubercle and the angle (which is often greatly thickened): at this spot in acute rickets infraction (spontaneous fracture) may not infrequently be found; secondly, at the anterior end. In cases of chest-deformity in infants, the tip of the rib is bent acutely on itself, the cartilage taking no part in many cases. So-called 'beading' of the ribs results from the proliferation which is going on at the costo-chondral junction; the expanded cartilage appears in some cases to fit on the rib like a cap, the enlargement being generally more marked on the inner than on the outer surface. The chest-deformities of later childhood are different, and follow no

regular type, being dependent on, and modified by, the effects of partial repair, of occupation, and of dress.

The *long bones* present certain pathological appearances on their surface, and along the epiphysial lines, which may be summed up as follows. The periosteum is everywhere thickened; it separates more readily than normal, owing to an unusual amount of newly formed hypervascular soft bone on the surface of the shaft; to its under surface, when so separated, will sometimes be found attached minute needle-like spicules of young bone, which have broken away from the shaft. On making a vertical section through the epiphysial junctions, the proliferative zone will be found increased from about half a line (as a normal) to as much as six lines or more in severe cases; and instead of being straight, it presents an irregular outline—that is to say, the cells are not arranged in rows as seen in normally ossifying hyaline cartilage, but are scattered irregularly over the whole ossifying area. The ossifying centre in the epiphyses is larger than usual, and is often of a *diffuse* character (Sutton). The changes consist in an increase, with deficient and irregular ossification, of the cell-proliferation, in the persistence of thickened cartilage-cells in these deficiently ossified layers, and in the formation of numerous small medullary spaces, even in the still unossified cartilage. The long bones undergo marked and quite characteristic deformities, which are usually attributed to a process of softening, and said to be part of the rickety process. On this point Glisson says: 'And first we flatly deny that the bones of children afflicted with this disease are more flexible or less stiff and friable than the bones of others.' The writer has osteotomised many deformed rickety bones in children from three to ten years of age, and has always found the bones remarkably hard; moreover, in the post-mortem room, he has never seen bones *presenting the ordinary rickety curves* in a soft stage, nor have any such specimens ever been demonstrated at the Pathological Society. If the bones were really softened, it seems hardly probable that the resulting deformities would be so uniform as they actually are in practice, while the fact of their spontaneously becoming straight without again softening, suggests some other explanation. The pathology of rickety bones varies of course with the age of the patient, and the stage at which they are examined; if the process is in full vigour, there will

be signs of increased activity, while later the appearance will be one of sclerosis and enlargement. Although spinal troubles are not infrequently complained of, there are no changes in the *vertebræ* which can be said to be characteristic: sometimes they are excessively spongioid, so that they may be cut with a knife (Barlow); the deformities in the vertebral column as a whole are chiefly due to a relaxed condition of the ligaments. Indeed, throughout the body, the *ligaments* suffer more than is generally recognised; they are nearly always more yielding, and as a consequence longer than in health.

Symptoms.—The onset of rickets may be so rapid as to deserve the term 'acute.' More commonly it is slow and gradual; indeed the earliest symptoms of the usual form generally escape observation, and rickets may long since have passed its initial stages, before it is noticed either by the child's parents or even by the doctor. It is very difficult to say what constitutes the first departure from the normal standard in many cases: a somewhat large head, with widely open fontanelles, profuse perspiration about the head, a dislike to sleep covered up, are common occurrences among well-fed, firm-fleshed infants at the breast, and yet the foregoing are signs *par excellence* of the rickety disorder. Presently, the epiphyses, markedly those of the lower end of the radius, begin to enlarge, and in time the child becomes 'double-jointed.' In many cases Elsässer's soft patches on the skull-cap (craniotabes) will be among the earliest symptoms; they are especially frequent in babies with thin, lank hair. In other cases the chest becomes deformed—prominent along the sternum, and sunken in along the costo-chondral junctions; the tips of the ribs will be found 'beaded;' dentition is irregular rather than late, as generally stated, or both; sometimes the spine grows out, and the child cannot sit up, or is altogether backward for its age. The ligaments may be loose, and the knees or ankles, or both, 'give in' whenever the child attempts to stand or walk. In the earlier months of life, rickety children are especially liable to catarrh of the bronchial and gastro-intestinal tracts; hence bronchitis, with its sequel of collapse, is common; or a weak and easily disturbed digestion, indicated by vomiting, diarrhoea, and offensive stools, will be the sign which betrays the disease. 'Rickets is not a cause of pyrexia; if the temperature rise above the normal level, a complication may at once be suspected' (Eustace Smith).

Convulsive disorders are a frequent and often the only morbid manifestation of the rickety diathesis; they are most common in children under two years of age, and belong to the earlier stages of rickets. These convulsions are usually said to be reflex; laryngismus stridulus and carpo-pedal contractions are practically confined to the subjects of rickets. Tetany also is closely associated with rickets (Abercrombie), and some cases of strabismus are due to the same cause; indeed, not less than two-thirds of all the convulsive attacks to which children are liable will be found due to, or associated with, rickets. In a few cases there is great tenderness; the child objects to being handled, and cries when it is raised up. Such are the clinical signs of rickets, varying a little with the period of life when the diathesis begins to make itself prominent, and with the organs or system chiefly or first attacked. The antecedents, or some of them, to which reference has already been made, on inquiry will almost certainly be made out. Occasionally, fidgetiness and 'growing-pains' point to the onset of rickets, or the bone-deformities come on more or less rapidly without an apparent cause.

As regards *individual symptoms*, it may be said that the *facies* is almost characteristic. There is a disproportion in size between it and the head; the latter tends to become square; the frontal eminences are large and prominent, and the sutures thickened and often distinctly elevated; on palpating the head it feels hard and lumpy. The teeth are said to be less durable than in healthy children, and the alveolar processes altered in form; but these symptoms are not very reliable or well-defined. There is a great tendency to sweat profusely about the head, which is very suggestive, and, as if they felt hot, these children throw off the bedclothes at night and prefer to sleep uncovered. The abdomen is generally prominent; the chest is nearly always flattened at the lower lateral parts, and more so on the left than on the right side; at the junctions of the ribs with their cartilages there is often 'beading.' The spinal column may be affected or not; owing to flabby muscles and loose ligaments, and sometimes to the weight of a larger head than normal, the child cannot sit up firmly; the spine then forms a curve, either backwards or laterally—the direction being determined by the posture which the child most frequently maintains. The deformities of the long bones may be said to differ within rather narrow limits; they

are very similar one to another, and so generally symmetrical that an affection of one side alone would bring the diagnosis into doubt. The tibiae, of all the bones, are perhaps the most frequently affected; the 'seat of election' is in the lower third, and the common curve is outwards and forwards. In a few cases the stress falls on the crest of the shin, which becomes prominent and sharp and curved. The fibula doubtless participates in these deformities, but from its deep position they are less manifest. The femur is less frequently affected; the commonest curve is in the upper third, and in direction outwards and forwards; in the lower third it curves inwards, and so contributes to the formation of knock-knee. The bones of the arms suffer markedly in a few cases, the humerus suffering more frequently than the bones of the forearm. The ligaments are nearly always flaccid, temporary knock-knees and flat-foot resulting in many cases. Rickety children generally grow slowly, they are large-boned, and their stature is often stunted.

Prognosis.—The prognosis in individual cases will vary with the child's age, the stage of the disease, and the absence or presence of complications. In uncomplicated cases a good prognosis can be given with confidence. By far the commonest cause of death is pulmonary or gastro-intestinal catarrh. The tendency to these diseases lessens as age advances, but they are very fatal to young children. A few children die of the nervous complications, either of convulsions or of laryngismus, especially when their origin in rickets is not recognised. As regards the deformities, it may be said that in ninety per cent. all traces disappear in process of time; in a few, permanent deformity of the bones remains. The thorax, especially, never quite regains its normal shape, if deformity has once been marked; and the same may be said of the skull. But in all other respects the children grow up strong and well, though it may be that their stature is somewhat dwarfed.

Treatment.—A consideration of the causes, just enumerated, which combine to produce rickets will suggest prophylactic measures of great value; for, whatever strengthens a woman's health strengthens that of the child she may be carrying or suckling, and whatever tends to deteriorate the mother's health, either before or after parturition, predisposes her child to rickets. The causes, among the rich late hours and various social exactions, among the poor the debilitating influences of poverty, must

be removed as far as possible, and a rational mode of living be insisted upon by medical men for all pregnant and suckling women, rich and poor alike. A large proportion of infantile mortality is directly due to causes acting on the children antecedently to their birth, combined with unsuitable food and attention subsequently. There can be little doubt that the best diet for an infant is its mother's milk, and any conditions or surroundings which tend to lessen either the quantity or the quality must be avoided. The cases in which mothers' milk is likely to be injurious to their own infants are extremely few; the writer doubts very much whether a mother can convey to her own child through the milk any constitutional taint or weakness, which it has not already inherited *in utero*. The excuses for not suckling children are often really trivial, and should be discountenanced by the medical attendant; the health of the mother is improved and her tendency to disease in the breast lessened by suckling, the temporary inconvenience being more than neutralised by the advantages which the proper carrying out of the physiological functions in the breast, entailed by child-bearing, brings with it.

Rickets is essentially curable, and cod-liver oil is the remedy for all forms of the disease. It should be given in doses of one teaspoonful or less, alone, or combined with either steel-wine or lime-water. Very few children fail to become reconciled to it, with perseverance on the part of their parents; when given alone, a teaspoonful of orange wine, or black coffee, or milk, forms an excellent vehicle, and a nicely flavoured lozenge removes the taste afterwards. Its use must be continued for some months, with short intermissions, and it is most useful when given shortly after food for it is then mixed, digested, and absorbed along with the food. Judicious management of individual symptoms is of course necessary. If an infant is suffering from the effects of an improper diet, improvement cannot be expected so long as this diet is continued. On the other hand, let it be ascertained whether *too much* food is not being given, and *too often*, before it is said to be improper. In a few cases the mother's milk distinctly disagrees: this may be a radical fault, or depend upon fleeting conditions of health easily remedied. In the former case, some other food must be tried, and given in addition to, or substituted for, the milk. *Fresh milk* (either cow's, goat's, or ass's), suitably diluted according to the age of the child, should

always form a part of the diet; it may be alternated with one or other of the many artificial (malTED) foods now in vogue, that one being finally selected on which the child thrives best.

There must be no hard and fast routine diet for all children; what agrees with one may disagree with another, while a little variety is beneficial to all. But in all cases, some *fresh* food—as opposed to the *prepared* foods—must be given. It is not an uncommon error to give the food too strong, and especially so in the case of weakly infants, who do not thrive; the more feeble an infant, the less can it digest complex or strong food; even cows' milk must be diluted more than usual; it may even be well to partially digest it by means of pancreatine before giving it. A fertile source of mischief is an unclean feeding bottle. Even with the best will it is not easy to keep the bottle and the tube thoroughly sweet; under these circumstances it is well to get new tubes and new teats at short intervals. A little pounded raw, lean meat is of great service in many cases, and can never do harm; from one quarter to half an ounce once or twice a day may be given. Fresh fruits, fruit-juice, part of an orange, or a piece of lemon (well sugared) to suck, a roasted apple or pear free from skin and husks, are valuable aids to digestion, even for quite young infants. For older children, green vegetables, lettuce, cress, celery, tender and fresh from the garden, should be given. A pinch of salt with the food must not be forgotten. It is well to avoid tea, coffee, and stimulants.

Next in importance to the food are fresh air and light in the nursery; for the latter a south or south-west aspect is the best; too high a temperature must be avoided, and the air constantly changed. Bathing is of great value to rickety children: with salt water, if it can be procured, if not, with sea-salt dissolved in the bath water as the next best substitute. The whole body should be well sluiced with a bath sponge for a minute or two, and then be systematically rubbed and shampooed; for an infant, and in winter for older children, the bath should be comfortably warm (90° to 95°), in summer it may be nearly cold; all chilling is to be avoided, and individual idiosyncrasies as to heat and cold carefully respected. When children are ill, and suffering from catarrh, the regular bath may be suspended for a time. Outdoor exercise should be taken every day. Flannel should be worn next the skin; it should reach well up to the neck, and as far down as the knees, in order to

protect without constricting the chest and the abdomen; for sleeping, a 'combination' dress is best; the children cannot then get entirely uncovered, as they are apt to do in the ordinary night-dress. The severer lung and intestinal complications must be treated on the principles laid down in the medical text-books; but it is well to say that cod-liver oil often acts like a charm, even in this stage of rickets.

Deformities, unless very marked, may be left alone; the crooked bones tend to straighten spontaneously under the influence of general remedies. In the case of severe deformities, light splints may be worn. The writer never uses splints which pass beyond the feet; if children are so splinted that they cannot walk, they shuffle about the ground, and take more harm from this mode of progression, and the dangers incidental to it, than the wearing of such splints compensates for. If the deformities resist treatment, or continue to progress notwithstanding, and become really severe, then osteotomy may be resorted to. But patience is the great requisite, as time and cod-liver oil are the remedies for such cases. When cod-liver oil causes diarrhoea, a minim or more of tincture of opium may be combined with each dose until the oil is tolerated. In warm weather, also, the opium sometimes proves a valuable adjunct, and permits the administration of the oil to be continued, when otherwise it could not be borne. See BOW-LEG; GENU VALGUM; OSTEOTOMY.

ACUTE RICKETS.—This term has been used by different authors in rather different senses. By some (Jenner, Ritter, Rehn) it has been used to denote an unusually rapid onset of the ordinary form of rickets; by others (Stiebel, Mauthner, Senator) to signify a very severe form of the disease with an acute onset. By Möller it is used to describe what he regards as a disease distinct from rickets, in which subperiosteal hæmorrhages or effusions are a characteristic symptom; by Bohn as an inflammation of bone in consequence of its over-rapid formation; while Henoch hardly believes in the existence of such a condition, chiefly because he has never seen a case in his own practice.

There is no doubt that rickets—like many other diseases—may have a very rapid onset, and occasionally, also, assume a very severe form, for which cases the term 'acute rickets' is very appropriate. Dr. Mauthner of Vienna, about thirty years ago, recorded some of the first and best cases. Dr. Möller of Königsberg also reported three

cases of 'acute rickets' in artificially-fed children, with enlargement of the joint-ends of several bones, occurring simultaneously or in rapid succession, and accompanied with such considerable persistent pain (which was aggravated by handling the children) that osteitis was suspected. There were no bendings in the bones, but in two subsequent cases, he found, *post mortem*, subperiosteal effusions of blood, with spongy (scurvy) gums and sugillations in one of the cases. Later again, Dr. Rehn of Frankfort described a series of cases of 'infantile osteomalacia,' which evidently belong to the same class as the foregoing. Dr. Thomas Barlow regards the term 'acute rickets' as inappropriate, and suggests that these cases are 'probably a combination of scurvy and rickets, the scurvy being an essential, and the rickets a variable element.'

The clinical history of these cases differs widely. The disease is not confined to the poor: it may occur up to three years of age, but is most common under or at about eighteen months; one of the earlier symptoms is pain, which is aggravated when the child is handled. Most of the cases have been in ill-cared-for, artificially-fed children of either sex, and without regard to season. The writer recently saw a well-cared-for infant with this condition highly marked, which had supervened in the middle of summer at Brighton. The duration rarely exceeds two or three months. In some, treatment has appeared of little avail, in others a cure has been effected in a week or two; while other cases have gradually, and for the most part slowly, recovered spontaneously. The general cachexia has not been at all profound, and, when death has occurred, it has been due chiefly to pulmonary catarrh, and not to the local lesions. In a few of the cases the gums are reported to have been spongy as in scurvy, and in some of the cases subperiosteal hæmorrhage has been found. The bones undergo strange deformities, quite unlike those of ordinary rickets; instead of being curved, they assume sharp angular flexions, termed 'infractures,' the epiphysal changes being usually ill-marked. The writer has examined three such cases *post mortem*, and feels no doubt as to the rickety nature of the lesion. Apart from the pathological appearances, there are the social surroundings which usually obtain in the more common form of rickets; the variation from the ordinary type is easily explained by the personal element present in all kinds of disease, and by the age of the patients when attacked. As regards the subperi-

osteal hæmorrhage, it is probably traumatic, and brought about by the rough handling to which many of the children are subjected before coming under treatment.

The appearance of the hæmorrhage early in the course of the disease, the absence of profound cachexia and of putrescence, and of stomatitis in many of the cases, distinguish this lesion from true scurvy. The latter disease, when it occurs in children, presents the same features as in adults, and it is brought about by the same causes—long privation of fresh, and the ingestion of improper, food *during cold damp weather*. It is quite exceptional for adults exposed to these conditions to escape scurvy; on the other hand, the cases of so-called 'infantile scurvy' are extremely uncommon, notwithstanding that an immense number of infants are being brought up on what Mr. Herbert Page describes as 'scurvy diet.'

Treatment.—The affected bones must be carefully protected from injury by appropriate splints; the less the limbs are handled the better. A child should be kept in the prone position, and be moved as little as possible. Place the child on a large soft pillow; instead of the usual dress, cover it with soft warm flannel, and in this way dressing and undressing will be avoided. Opiates may be given to relieve pain, if acute. General treatment must be on the lines already laid down—fresh food and fresh fruits being of great value.

FETAL RICKETS.—This term is now reserved for a peculiar form of disease in fetuses, which consists in profound changes in the skeleton having a superficial resemblance to rickets, but which are frequently associated with absence of the thyroid gland, or with premature synostosis of the basi-occipital and basi-sphenoid, or sometimes with both. This condition is also and more appropriately called 'fœtal cretinism;' the severer forms of the disease appear to be incompatible with life, for the cases described have been still-born fetuses of varying ages. A few isolated cases had been previously recorded, but Virchow was the first to describe the condition at all accurately. Many cases have since been reported. The extreme shortness of the diaphyses, relatively to the large size of the epiphyses, is the most marked pathological feature; microscopically examined, there is very deficient ossification at the epiphysal line, with intrusion of fibrous tissue from the periosteum, which Mr. Bowlby regards as the cause of the shortening and of the changes in the cartilage. The premature synostosis at

the base of the cranium has been found in several cases; but it is not invariable. Virchow regarded this as the distinct feature of this condition, and the cause probably of the arrested brain-growth. As for the thyroid gland, it has been found absent in some cases and present in others; the part which its absence or presence plays in the causation of this form of cretinism cannot therefore be estimated. A goitre has been found in some cases, and in a few others peculiar masses of fat above the clavicles are met with. Children with the less severe forms of the disease not only survive their birth, but may live for many years. Not infrequently one of the earliest signs of their cretinoid condition is hypertrophy of the tongue, which projects beyond the lips. Then the child gradually assumes the look of hebétude which is characteristic of the disease; intellectual and bodily development are greatly impeded, so that they still appear young children even at sixteen or eighteen years of age.

Authorities agree in regarding this condition as entirely distinct from ordinary rickets. It would be well, therefore, to discontinue the term 'fœtal rickets' and substitute 'fœtal cretinism.' Dr. Barlow points out how the disease attacks the cartilage bones only, the bones which are formed in membrane being all well developed. The enlargement of the *whole* epiphysis; the thickening of the shafts of the long bones, which are hard and compact; and the absence of rarefaction in the medullary part of the bones distinguish the condition from true rickets.

LATE RICKETS.—Cases of rickets commencing at eight, nine, or ten years of age are by no means rare, though exceptional. Glisson refers to a case of rickets in a man twenty years of age. In the Middlesex Hospital Museum are casts of rickety deformities of the legs in a young man aged twenty, which appeared after an operation for genu valgum. The writer has seen two cases of typical rickety deformity in subjects fourteen and sixteen years of age, which were said to have 'come on quite lately.' Besides these, several anomalous cases of bone-disease in young adults have recently been put on record, in which the epiphyses have shown rickety enlargement, while the shafts have presented other changes less easy to define. By some, the condition is regarded as a juvenile osteomalacia, and an attempt has been made to trace a connection between this latter disease and rickets; the differences between extreme cases are quite obvious, while intermediate ones—that is to

say, cases of late rickets and of early osteomalacia—are said to merge one into the other.

The writer is not at all inclined to acquiesce in this view. It is obviously unscientific to argue, because the ultimate outcome of two processes is more or less alike, that, therefore, they are identical. Pathological processes must rather be interpreted in the light of the clinical history. The rickets of infancy and childhood is a general and not a local disease, and death never takes place in consequence of the local bone-manifestations. Osteomalacia, on the other hand, is a disease of adult life, and of bones which were once absolutely healthy. The disease, unlike rickets, is local in its commencement, and remains so for years in some cases, while steadily progressing nevertheless; all the other functions of the body go on unhindered. Women, whom the disease chiefly affects, bear children; their intellectual power is unabated, and all the other functions may go on normally. Osteomalacia is a degeneration, a softening of healthy bones; rickets is an arrested and deficient development, not of the bones only, but a condition in which all the tissues participate. In a few exceptional cases, rickets may come on later in life than usual, just as osteomalacia may occur a little earlier. Rickets, however, is a very uniform disease, especially as it affects the bones, and the resulting deformities resemble each other as closely as the manifestations of the most specific diseases; the same may be said of the osteomalacia of women. The intermediate cases, which differ immensely among themselves, must, for the present, be relegated to a separate category. The causes which lead to this condition are not known. There can, however, be little doubt that late rickets is the expression of debilitating influences, of one kind or another, acting on the organism at large.

RELAPSING RICKETS.—A term applied to those cases in which the disease, having been apparently arrested for a year or two, again becomes active. Such cases are by no means uncommon when looked for. In the writer's opinion many cases of 'late rickets' may be accounted for on this supposition. Intervals of a year or eighteen months or even longer occur, during which no further signs of rickets manifest themselves. Then, owing either to want of care, to untoward surroundings of various kinds, to acute illness, or to change of air from a dry open country to a cold, moist, overcrowded town, sometimes without appreci-

able cause, a child's health gives way, and rickety (generally bone) disorder again shows itself. The symptoms vary with the age of the patients, and with their early bringing up. Knock-knees and other deformities arising from loose ligaments, such as spinal curvature and flat-foot, generally belong to this category. The treatment of these conditions must be conducted on the principles already laid down.

ROBERT WILLIAM PARKER.

RIDER'S BONE or RIDER'S STRAIN.—In persons who ride much, a hard lump sometimes forms on the inner side of the thigh, near the pubes. It is due to an ossification of the tendon of the adductor longus or gracilis, or to an exostosis growing from the pubes, and extending along the adductor tendon. There is a history of a severe strain, which has ruptured some muscular or tendinous fibres, or torn the tendon partially from its insertion. The subsequent irritation of the saddle causes the growth of bone. No treatment is of any avail, but this does not matter much, seeing that the swelling is more troublesome from its size and situation than from any pain it causes, and is very rarely seen in this country.

A. G. MILLER.

RIGOR is the name given to an aggregation of phenomena, all referable to the central nervous system, which, while frequently heralding the appearance of more unequivocal signs of serious mischief, are not necessarily developed in proportion to the gravity of the illness.

Symptomatology.—A patient, the subject of a severe rigor, lies shaking from head to foot, with tremors (frequently amounting to violent clonic spasms) affecting every muscle; consequently, the teeth chatter, the face twitches, the eyelids and corners of the mouth making opening and shutting movements; the head, supported on each side by the pillow, rarely moves much, the body often rolls in the bed, from the jerking impulses given to it by the violent contractions of the muscles which pass from the trunk to the limb-bones. Indeed, the bed is very frequently shaken by the violence of the tremor.

All this time, although the temperature is rising and may be up to 104° F., the patient complains very much of feeling intensely cold, and covers himself with every possible wrap, or gets close to the fire. There are no symptoms to indicate any active change occurring in the highest

nerve-centres, for the patient is always perfectly conscious, and sometimes his special senses appear to be rendered more acute. The clonic spasms, though varying considerably in force, exhibit a fairly constant rhythm, the rate of which appears to be frequently the same as that of ankle clonus, but sometimes of only half that rate.

In addition to the above-mentioned motor symptoms, others are often seen which indicate disturbance of centres for functions besides movement. Thus, vasomotor changes are observable in the shape of a leaden colour of the skin, which is dry and rough. Other centres in the medulla oblongata are also disturbed, so that the patient may be nauseated or actually vomit, the respirations may be slowed, and the action of the heart enfeebled and quickened. As indicated above, the temperature is usually rising at the time when the rigor occurs, for a rigor customarily occurs when the temperature has gained from one-half to two-thirds its maximum height.

Etiology and Causation.—There is no striking peculiarity about the array of symptoms, familiarly termed a rigor, which furnishes us with the slightest clue to its causation in fully ninety per cent. of all cases; for while we know so little respecting the origin and causation of acute specific fevers, it is clear we shall remain ignorant of that pathological state of the central nervous system which produces the rigor heralding the onset of the disease.

There only remains to us the suggestive fact of rigors being sometimes produced by traumatic influences. It is well known that, after sudden dilatation of the urethra by a catheter, there frequently follows a violent rigor, accompanied by a rise of temperature. See URETHRAL FEVER. In such a case, we have simply the irritation of peripheral nerves causing a profound disturbance of the spinal cord and medulla oblongata. Of the accuracy of this pathology there can be very little doubt, but it would be very improper to apply it to explain the occurrence of rigors in pyæmia, ague, &c., until the causes of those diseases are thoroughly known. That rigors are of central origin is obvious, and the only question is the mode of irritation which the nerve-centres suffer.

Treatment.—The treatment of a rigor has almost always been the simple plan of stimulation and heat, in the shape of doses of brandy and hot water, extra blankets, and hot bottles. If it were not for the

concomitant disturbance of the heart, &c., rigors would require but little attention. It has been shown, experimentally, that any drug which narcotises the nerve-centres exerts thereby a powerful preventive effect on rigors and pyrexia. Thus, Dr. Johnson proved that chloroform, &c., would arrest a rigor, and it is well known that morphia and quinine will prevent and arrest rigors due to catheterism, and possibly those occurring in pyæmia. But, for practical purposes, it will be found best to administer a hypodermic injection of morphia (gr. $\frac{1}{4}$ to gr. $\frac{1}{2}$), to cover the patient with blankets, to warm the surface of the body with heated air or hot-water bottles, and to supply him freely with hot alcoholic drinks. For the prevention of rigors, see URETHRAL FEVER.

Prognosis.—As far as the rigor itself is concerned the prognosis is always very favourable, however alarmingly violent the spasms may be; but, as indicating other mischief, the occurrence of a rigor will always render the prognosis very serious, and, if there is concurrently suppression of urine, &c., it will make it practically hopeless.

VICTOR HORSLEY.

RINGWORM. See *TINEA TONSURANS*.

RISUS SARDONICUS. See *TETANUS*.

RODENT ULCER. See *CARCINOMA*; *ULCERS*.

ROUGE'S OPERATION may be required for the removal of necrosed or carious bone when, either from the size of the sequestrum or from the situation of the disease, this cannot be effected through the nostrils. It may also be resorted to for removing certain forms of nasal and naso-pharyngeal polypi, when more room is required than can be obtained through the natural passages, and when it is especially desired that no external scar should remain. Further,

it is sometimes useful for allowing the introduction of the finger into the nasal chambers, for the purpose of thoroughly exploring these parts in cases of long-standing disease attended with foetor, where the presence of diseased bone is suspected but cannot be detected by the mirror or probe.

The operation is performed as follows:—The upper lip having been seized on each side near the corner of the mouth and turned upwards, an incision should be made, reaching from the first pre-molar tooth on one side to that on the other, through the mucous membrane at its reflection from the lips to the gums. The tissues intervening between the mouth and the nasal cavities should next be rapidly divided, and the cartilaginous septum detached with the bistoury from its insertion into the anterior nasal spine. This is often sufficient to allow of the introduction of the finger and the exploration of the nasal cavities; but if more space is required, the lateral cartilages should be detached from the maxillary bones with the scissors, when the nose, thus completely freed, can, especially when the septum has been partially destroyed by the disease, be turned upwards towards the forehead, widely exposing the orifice of the nasal chambers. Where the septum is intact, it will generally require further separation from the maxillary crest by the scissors. The removal of the dead bone or growth, or the exploration of the nasal cavities, having been effected, the lip and nose should be accurately replaced, care being taken that the base of the septum is placed in exact contact with, and is supported by, the nasal spine. No sutures are necessary; little or no swelling of the lip follows the operation; there is, as a rule, no constitutional disturbance, and the parts are usually soundly healed in a few days. W. J. WALSHAM.

RUPIA. See *SYPHILIS*.

S

SABRE and BAYONET WOUNDS. Sabre wounds chiefly affect the head and upper extremities, bayonet wounds are chiefly on the lower extremities. Neither are very fatal, the bayonet wound being rather more so than the sabre.

Sabre wounds.—The sharper the weapon, the more the injury inflicted will resemble an incised wound. When the sabre is very sharp it may cut a portion of

tissue completely away. The blunter it is the more irregular and contused the wound will be, and the deeper the weapon penetrates the more it will gape. When the cutting edge strikes the surface perpendicularly, a straight gaping wound will be inflicted; if obliquely, one margin may be concave, the other convex, or the wound may be more or less flap-shaped, especially on the face and skull. When the

bone is implicated by a blunt weapon, it may be bruised or fractured; if sharp, it will be incised or a portion more or less completely detached. The bleeding is not great unless a considerable vessel be injured or the weapon very sharp. If the large veins in the neck are wounded, sudden death may take place from entrance of air. The amount of pain will depend on the nervous supply to the injured part. When large nerve-trunks are divided, there will be interference with sensation and movement in the parts which they supply.

A blow of a blunt sabre on the head will often produce injury of the brain-convolutions of the opposite side, or fracture the skull; especially will the internal table be injured and extensive fissuring produced. The skull and face are most often wounded; next to these the hands and arms almost as frequently. These wounds are much rarer on the chest and back, and very infrequent in the abdomen and lower extremities.

Punctured wounds are caused in time of war by bayonet, lance, and sabre. They are by no means of frequent occurrence, and as seen in the hospitals are not of great severity. There is no accurate information as to the number which prove fatal on the field. They are chiefly met with in the breast, abdomen, and upper extremities; less frequently on the head, face, and lower extremities. They are usually long blind canals with a triangular or quadrangular wound in the skin, according to the form of weapon. The bone may be perforated or fractured. They often contain foreign bodies or a portion of the weapon which has broken off. The vessels often escape in a remarkable manner, and a comparatively small wound in the vessel may sometimes close after the primary hæmorrhage has ceased, frequently to be followed by a traumatic aneurism. When the wound implicates both the large artery and vein, aneurismal varix may follow; nerves may be punctured or divided, and tetanus is then comparatively common. These wounds often penetrate cavities and injure the contained viscera. Cut and thrust wounds may heal by first intention without suppuration, or their progress may be modified by all the circumstances which influence the course of gunshot injuries.

The prognosis will depend on the depth and extent to which they implicate important cavities or organs.

The treatment consists in the arrest of hæmorrhage, the extraction of foreign bodies, and antiseptic purification.

WILLIAM MACCORMAC.

SACRO-ILIAC JOINT, Disease of the.—This joint is not often the seat of primary disease, but is more usually affected secondarily by the spreading of caries from the adjacent surface of the ilium or sacrum. The disease is generally of constitutional origin, and is for this reason, as well as because of its anatomical relation to the spine and pelvis, to be looked upon as an affection of much gravity. It may, however, originate in injury, and occasionally follows parturition.

The earliest *symptoms* of sacro-iliac disease are usually pain and slight lameness. The pain may be felt in the situation of the joint, or in the course of some of the neighbouring nerves. Most often it is felt along the great sciatic nerve and its branches, so that, in the early stage, sacro-iliac disease is apt to be mistaken for sciatica. Not uncommonly also the pain is referred, as in hip-disease, to the hip and knee, in consequence of irritation of the obturator nerve. The pain, wherever it may be, is increased by movement, and whenever the weight of the body is transmitted through the pelvis, as in sitting or standing; so also, an attempt to lift a heavy weight from the ground will generally elicit or aggravate pain. On the other hand, relief is given by the recumbent posture. The lameness at first is chiefly due to slight involuntary elevation of the pelvis on the affected side. Sometimes there is flexion of the thigh, in consequence of irritation of the psoas muscle. As the disease progresses, tenderness will be felt on pressure over the joint; pain will be produced by pressing together the two iliac bones; the gluteal muscles will become wasted; and suppuration will occur. When matter forms, it will most commonly present over the back of the joint, but it may also make its way to the groin after the manner of a psoas abscess, or outwards along the crest of the ilium, or forwards towards the rectum, from which it may be felt by the finger.

Diagnosis.—It will be observed that, in many respects, the symptoms described closely resemble those of disease of the spine or hip, and in the commencement of sacro-iliac disease a careful examination is needful to distinguish it from those affections. From disease of the spine, it will differ chiefly in that the symptoms are referable to one side only of the body; and that if the pelvis is fixed, flexion of the vertebral column is not restricted or painful. From hip-disease, it may be distinguished by the free mobility of the femur independently of the pelvis.

Pathology.—The disease usually begins either in the bone or periosteum, though possibly, in some instances, the starting-point is an extravasation of blood into the tissue about the joint, the result of direct injury. In advanced cases the articular surface is found carious, the fibro-cartilage loose, the ligaments softened, and the joint surrounded by extensive suppuration.

The *prognosis* will depend chiefly on whether the disease is of constitutional or local origin, and upon the extent to which the mischief has progressed before treatment is commenced. In the scrofulous or phthisical the affection is always a grave one, as it must also be considered whenever suppuration has occurred.

In the *treatment*, the first essential is absolute and prolonged rest in the recumbent position. The immobility of the joint may be aided, moreover, by surrounding the pelvis with a well-moulded leather splint or a padded pelvic girdle. The only local application of any use, is the light and repeated application of the actual cautery over the back of the joint. This is, of course, only serviceable during the early stage of the disease and before suppuration has been reached; but at this period it sometimes gives remarkable relief to the pain, especially to that along the course of the sciatic nerve. Blisters and other milder counter-irritants have no effect but that of adding to the discomfort of the patient.

When abscess has formed it is generally best to open and drain it, with antiseptic precautions. If not opened, abscesses are prone to attain a large size, and to burrow in a manner which makes it subsequently very difficult to drain them efficiently; if aspirated they usually rapidly refill. No doubt cases have occurred in which such abscesses have undergone so-called absorption—that is to say, they have dried up; but this implies a residuum of caseous material which may be the source of future dangers. In phthisical cases it is, perhaps, best not to interfere with the abscess unless it is distressing the patient.

When the disease becomes arrested, and only a sinus remains, it may be useful to explore the part to ascertain if there be any removable dead bone, or for the purpose of scraping away the granulations which supply the pus; but these measures should not be resorted to till every opportunity has been given for natural repair. Besides the local measures which have been indicated, the constitutional condition of the patient should receive attention. As a long period of recumbency will be necessary, it

is important to secure the best possible environment; while, at the same time, nutrition should be aided by good food, cod-liver oil, or other suitable tonics.

J. WARRINGTON HAWARD.

SACRUM, Fracture of the. See PELVIS, Injuries of the.

SALIVARY CALCULI are concretions of earthy salts deposited by the saliva, and consist of phosphate and carbonate of lime, with a little magnesia, chloride of sodium, and some organic matter. They are usually of elongated form and small size, but may attain very large dimensions; thus, Albert has seen one removed from Wharton's duct which measured over an inch and a half in length, and was as thick as the little finger; and he mentions another as large as a hen's egg, taken from the duct of the parotid. They are most frequently met with in connection with the duct of the sub-maxillary gland, but the ducts of Stenson, Rivini, and Bartholin may also be involved. The obstruction of the tube is rarely complete.

They may appear at any age, and are said to be more common in men than in women. Their development is seldom explicable, but in a few cases the nucleus of the stone has been found to consist of a grass seed or some other foreign substance.

The *symptoms* are usually slight. The patient complains of a sense of discomfort and tension in the situation of the impacted calculus. The gland, from retention of secretion, undergoes painless swelling, which continues until the imprisoned fluid forces a way past the foreign body; the engorgement then rapidly subsides, to be followed by a new accumulation, and a characteristic alternation of tumefaction and collapse becomes established. Cystic dilatation of the tube behind the obstruction is very rare.

The *diagnosis* is effected by careful palpation along the course of the ducts, aided, if necessary, by the introduction of a fine metallic probe.

The calculus may be removed through an incision made into the distended portion of the duct, or the tube may be laid open from its orifice as far as the obstruction. The continuous flow of saliva prevents any tendency to stricture after the operation.

WILLIAM ANDERSON.

SALIVARY FISTULA.—A sinus opening upon the outer surface of the cheek, and communicating with the duct of the parotid gland.

Such sinuses have origin either in wounds of the duct, or in abscess which has burst externally, or in obstruction of the buccal end of the duct, causing its distension and subsequent opening on to the surface of the cheek. Much discomfort is produced by the escape of the saliva upon the cheek; the flow of the secretion being of course increased during mastication.

Treatment.—Fistulæ of recent formation may sometimes be made to heal, if the buccal orifice of the duct be quite free, by covering the opening on the cheek with collodion, a layer of which must be reapplied from time to time, so as to prevent the escape of any saliva; fluid food only being taken during the treatment.

If this does not suffice, the edges of the opening should be pared, and then transfixed with a fine needle, over which a figure-of-eight ligature is to be tied, so as to bring them into accurate apposition. The needle is withdrawn at the end of forty-eight hours, and the wound covered with collodion. Or the orifice of the sinus may be first cauterised with a hot needle and then similarly covered. If the buccal opening is contracted or closed, this must be reopened by passing a fine probe through it; or, if it cannot be found, a probe must be passed along the duct and into the mouth as nearly as possible to the natural orifice (near the second upper molar tooth). Then the duct must be kept open by passing a flexible probe or bougie along it from the mouth, past the fistula, and as far as the gland. This is retained by curving the end which projects from the mouth round the angle of the cheek, and fastening it there by plaster. The fistulous opening is kept covered with collodion, and mastication avoided. J. WARRINGTON HAWARD.

SALIVATION. See *Mercurial Stomatitis* under STOMATITIS.

SALTER'S SWING CRADLES. See CRADLES.

SANDBAGS are useful for steadying broken limbs, either alone or with splints; and in combination with a drawsheet laid over the chest and abdomen and under the sandbag which is placed along each side of the patient, they efficiently overcome the aching of the spine which occurs in the extension treatment of hip-joint disease. The bags should be made of some fine-textured material, such as bed-ticking, and should be only about two-thirds filled with sand, which must be as fine as possible and thoroughly dried.

SAPRÆMIA is a term which may, perhaps, etymologically include more than it is now generally understood to mean; but, expressing as it does very succinctly the condition in which there is present, circulating in the blood of a patient, one of the alkaloidal products of decomposition (*see* SEPSIN), a condition which is otherwise known as septic intoxication—a cumbersome title—or as septic poisoning, which is much too vague, it at least has the merit of brevity coupled with sufficient accuracy to commend it for permanent adoption. By the term *sapræmia* we understand the condition which is sometimes very wrongly called traumatic fever, or, what is worse, simple traumatic fever. The *sapræmic* fever is one, therefore, which is evoked by the entrance of a chemical substance into the bloodstream, and, as a necessary consequence, it disappears directly all possible source of absorption of ptomaines is removed.

But in thus entering the threshold of the subject of SEPTIC DISEASE we must first take note of another pathological (febrile) condition, which is possibly sometimes confounded with *sapræmia*. We refer to poisoning by the so-called blood-ferment. It has now for some years been recognised that the direct agent in the production of fever is usually a derivative (a non-organised substance) of animal tissues. Volkmann and Genzmer, following the line of thought already pioneered by Billroth and Weber, came to the conclusion that the cause of the pyrexia, in cases which had been operated on strictly antiseptically, was a hypothetical substance, 'pyrogen,' which was a derivative of the damaged portions of the tissues operated upon. The researches of Bergmann's pupils—notably Angerer, Edelberg, Köhler, and others—have vividly illuminated this obscure point by their experiments with blood-ferment and the various constituents of the blood. We will here preface their conclusions by recalling to mind the conditions under which ferment-poisoning most probably arises. In cases where considerable venous oozing has occurred, the wound-cavity is full of black clot or black treacly serous discharge, this bloody débris being frightfully septic if the antiseptic precautions have failed; but, if these are successful, of course it is perfectly aseptic according to the tests at present at our disposal, so that that complication does not exist. Further, it is a necessary condition that the drainage of the wound should have been insufficient, and consequently a positive pressure set up in the interior of the wound, so as to mechanically aid the

absorption of its fluid contents. Both conditions are not infrequently produced by the removal of large tumours, &c., from the fossæ of the body.

The most noteworthy contents of the wound, then, are—(1) partly clotted blood, (2) serum (simple), (3) serous exudation, (4) blood-pigments (hæmoglobin, &c.), (5) blood-ferment (Schmidt). Besides these well-known substances there are, no doubt, others to which perhaps some of the effects to be noted presently are due; among these substances the body recently separated by Wooldridge is particularly to be noted.

All the foregoing components of such wound-discharge are pyrogenous; injected into the blood-stream of a healthy animal, each of them excites more or less pyrexia. The injection of a solution of blood-ferment produces symptoms exactly similar to those which follow the injection of sepsin, for there soon ensue tremors, vomiting, cramps, and bloody diarrhœa, while the temperature rises to over 105° .

Enough has been said to show that in 'ferment-poisoning,' as at present understood, we have a severe pyrexial condition, due to the action of the ferment on the central nervous system (any ferment will do the same thing—viz. pepsin, trypsin, &c.), and that, recognising the possible occurrence of this condition, it must always be eliminated in framing a diagnosis in a supposed case of sapraemia.

The etiology of sapraemia is at first sight simple enough—viz. the setting up of ordinary decomposition in a wound which is imperfectly drained; but, in reality, there are more complex conditions attendant upon the course of the putrefaction. These external conditions determine the form of sepsin produced, and hence indirectly the symptoms. Thus, quite recently, Schmiedeberg and a pupil have found that the original ptomaine, called sepsin, is only to be obtained under certain definite atmospheric and other conditions. The same fact is well known to mycologists to influence the evolution of Davaine's septiciæmia.

Similarly, the duration of the 'incubation period,' or rather 'latent period,' which elapses before the first symptoms of poisoning appear, varies directly with the dose, so that no general rule can be laid down on this point.

Next, we must consider briefly the mode of entrance and exit of the poison. As a rule, the poison is absorbed from the cavity of a foul wound by the veins and lym-

phatics, and it may easily be observed, clinically, that the absorption is largely influenced by the (mechanical) tension of the decomposed discharges in the wound. When, however, there is a septic inflammatory process about the mouth or pharynx, as in *cancrum oris*, &c., then the patient swallows quantities of putrid stuff; and in that case, of course, the absorption is *per* the lymphatics of the intestine and stomach. Finally, where the nose has been the seat of primary putrid inflammation, sapraemia has followed the inhalation of the poison, and the same thing has been observed in the lower animals.

As described in the articles on SEPSIN and SEPTIC DISEASES, the poison is mainly excreted by the kidneys.

Symptomatology.—Just as in the lower animal the subject of experiment, so in the human being, the most prominent symptoms are those produced by disturbance of the nervous system. The first effect of absorption of a ptomaine or sepsin-like substance is headache (frequently very severe); this is followed by nausea and vomiting. A slight rigor may announce the commencement of the rise of temperature, which usually reaches 101° – 103° F., and very rarely 104° ; the pyrexia is a continued fever until the wound is thoroughly washed out with disinfectant lotion and completely drained, when it disappears at once. (This immediate effect proves that the sapraemic state is due to the absorption of a simple chemical substance, and is in no sense of the word an infective condition.)

Marked changes occur simultaneously in the blood; the patient becomes anæmic, for the red blood-corpuscles vary directly with the amount of poison circulating. There is some leucocytosis also, but the greatest effect is on the number of red discs.

At the same time the excretory organs, which are occupied in getting rid of the poison, are notably affected. The skin is cold and clammy, the urine scanty and concentrated, and sometimes there is diarrhœa, which more rarely is bloody. Diarrhœa, in fact, is next in importance as a leading symptom to those evoked from the nervous system. In final stages, if not previously relieved, the patient becomes delirious, and then the delirium passes into fatal coma. The symptoms will differ according to the difference in the kind of decomposition set up, since the resulting ptomaine poison will be different. See SEPSIN.

Pathological Anatomy.—There is little to be found in the post-mortem appearances

of such a case. The most obvious changes are usually found in the alimentary canal, in the shape of violent gastro-intestinal inflammation, the mucous membrane being intensely congested, small extravasations of blood occurring here and there, and Peyer's patches especially swollen and reddened. Similar small extravasations of blood or petechiæ are found beneath the serous membranes. The central nervous system exhibits marked congestion also of the meninges, and occasional hæmorrhagic petechiæ.

The glandular organs, the liver and kidneys, but especially the latter, show well-marked bloody swelling, while the spleen is frequently (but not invariably) swollen. As has been observed in other septic diseases, the corpse of a person who has died of sapræmia becomes putrid very rapidly.

Treatment.—Fortunately, the treatment of this variety of septic disease is easy and almost always very successful, since it simply consists in the thorough cleansing of all putrid stuff from any of the cavities (especially mucous ones) of the body. All wound-cavities, &c., must be freely drained by fresh incision, large tubes being inserted as a preliminary measure, and are then to be freely syringed out with strong disinfectants—e.g. 1 in 20 carbolic acid, &c. In cases where the sapræmic state follows on the advent of a septic inflammatory process, that must be treated by free incision and washing under anti-septic precautions.

Although the local treatment is the one essential point in successfully combating sapræmia, still, there are other factors in the etiology, &c., of the disease which have to be considered and met. Thus, for instance, there is the secondary anæmia and leucocytosis. This is to be treated with iron and quinine. The former is best given as dialysed iron, $\mathfrak{m}x.$ bis die, and the latter simply dissolved in dilute acid, 15 grains per diem to commence with, and increased as soon as possible. But it will be observed of a series of cases that the symptoms differ to an obvious extent. This is doubtless due to the difference in the kind of ptomaine which may be doing the mischief. *See SEPSIN.* And it may occasionally happen where there are very distinct minor nerve-symptoms—e.g. dilatation of the pupil, dryness of the throat, &c.—that the condition will be best met by administering the vegetable alkaloid which is antagonistic to the one that appears to be imitated by the particular ptomaine under

observation. Thus, if the above-mentioned symptoms were present, it might be of advantage to inject eserine hypodermically. *See HYPODERMIC INJECTION.*

Finally, we would repeat that sapræmia is usually a complication of some infective disease, and that altogether it may be treated apparently successfully in a few days. The chance of the patient's having contracted pyæmia, &c., must be borne in mind. This is notably the case where the sapræmia is of puerperal origin.

Prognosis.—Good, if a simple case.

VICTOR HORSLEY.

SARCOCELE. *See* TESTIS, Diseases of the.

SARCOMA.—*Structure.*—The sarcomata may be defined as tumours of connective-tissue origin, composed of connective-tissue cells. There is often no definite stroma, and, when present, it is—with one rare exception—not arranged in the form of definite alveoli, the cells being uniformly distributed throughout the tumour. The sarcomata are generally largely supplied with blood-vessels, the smallest of which are extremely thin-walled and sometimes appear as channels bounded merely by the cells of the growth. No lymphatics have ever been demonstrated. The cells multiply by fission.

The sarcomata may be conveniently divided into four chief groups—(i.) *round-celled*, (ii.) *spindle-celled*, (iii.) *mixed-celled*, (iv.) *giant-celled* or *myeloid*.

(i.) **ROUND-CELLED SARCOMATA.**—These tumours are composed of round, granular cells of connective-tissue type, frequently multi-nucleated, not generally varying in size in any individual tumour, embedded in a soft, granular, or homogeneous matrix, abundantly supplied with blood-vessels. In some tumours the cells are no larger than leucocytes—small round-celled sarcoma; in others they are more than double or treble this size—large round-celled sarcoma. The cells have no definite cell-wall, and there is often but little protoplasm around the nucleus.

(ii.) **SPINDLE-CELLED SARCOMATA.**—The spindle-celled sarcomata consist of closely packed spindle, oval, fusiform, and oat-shaped cells, generally granular and often multi-nucleated, embedded in a homogeneous matrix. The cells are for the most part arranged with their long axes parallel, but are frequently collected into interlacing bundles. They vary in size in different tumours, but in any individual growth are frequently of

the same diameters throughout. In the small spindle-celled variety their diameter does not exceed that of a leucocyte, and is about one-fourth that of their length, while in the large spindle-celled sarcomas, the cells are sometimes as much as five or six times these dimensions.

(iii.) **MIXED-CELLED SARCOMATA.**—The mixed-celled sarcomas, as their name implies, are composed of cells of various forms, such as may be met with separately in either of the two previous groups. The cells frequently differ in size as much as in shape.

(iv.) **GIANT-CELLED OR MYELOID SARCOMATA.**—These sarcomata are composed for the most part of spindle or oval cells, such as have been already described. Mingled with them, however, are a varying number of large, irregularly shaped cells, often twenty to thirty times larger than their neighbours, granular, flattened, and containing from ten to forty or more nuclei.

Varieties.—Although all sarcomata may be classified in one of the above four groups, yet it is convenient to subdivide them into several varieties, each of which differs in some important essential from the others. The following are the chief varieties.

MELANOTIC SARCOMA.—These tumours are distinguished by the presence of granules of black or brown pigment, in varying amount, scattered through the growth in a very irregular manner, and often absent in one part of a section, while, in another portion, the structure is hidden by masses of colouring matter. Most of the melanotic tumours belong to the round-celled variety of the sarcomata, but in some cases the pigment is found in spindle-celled growths. The pigment occurs both in the cells and in the matrix. Melanotic sarcomas are also not infrequently 'alveolar' with respect to their stroma. See *Alveolar Sarcoma*.

LYMPHO-SARCOMA.—The lympho-sarcomata are composed of very small round cells, lying in a slender, fibrillated matrix; the cells are no larger than leucocytes, and a section of such a growth is almost a *facsimile* of the more cellular part of a lymphatic gland.

GLIOMA.—The gliomas resemble closely the lympho-sarcomas. Their matrix is precisely similar to the neuroglia tissue in the nerve-centres, being a loose meshwork with branching cells. The sarcoma cells are of the small round variety. See *RETINA*.

ALVEOLAR SARCOMA.—The cells in alveolar sarcoma are generally round, but

may be oval or spindle in shape. They are contained in separate alveoli, formed by bundles of connective-tissue. The amount and consistency of this latter is very variable; it is generally much less than is present in the carcinomata, and is sometimes represented by a few fibres and long spindle-cells placed side by side. It is, in some cases, difficult to distinguish the sections of these growths from the alveolar carcinomata. It should therefore be noted (1) that the cells are generally smaller and more granular, and do not possess a translucent body, as do typical epithelial cells. (2) That in any alveolar sarcoma there is often a portion of the tumour composed simply of typical sarcoma-tissue without alveolation. (3) That the cells may be separated from each other by delicate filaments of connective tissue.

HÆMORRHAGIC SARCOMA.—These sarcomas belong to the round or spindle-celled groups. Their peculiarity consists in the extreme tenuity of their blood-vessels and the consequent liability to hæmorrhage, for as fast as they grow peripherally their central parts are broken down by extravasation of blood into a soft mass, which soon becomes indistinguishable from altered blood-clot, of which, indeed, it is almost entirely composed.

PLEXIFORM SARCOMA OR CYLINDROMA.—This rare form of tumour is essentially a sarcoma, some of the cells of which have undergone a hyaline degeneration. The unaltered masses of cells thus appear on section to be contained in alveoli, the walls of which are composed of hyaline material. The cells are generally round, but not infrequently polygonal, are closely packed, and not apparently separated by any intercellular substance. In some cases, the hyaline degeneration may be traced as commencing in the walls of the blood-vessels.

PSAMMOMA—PEARL TUMOUR.—This form of sarcoma has hitherto been found only within the cranial cavity, and, usually, in connection with the pineal gland. It is characterised by the presence of concentric calcareous masses, surrounded by fibrous tissue and attached to fibrous trabeculae.

Degenerative processes in the Sarcomata.—The most common form of degeneration seen in the sarcomata is that known as 'mucoid.' It usually commences in the most central parts of the growth by the distension of the cells with a clear gelatinous fluid, the cells burst, and the mucous fluid is discharged. In some cases the matrix seems to undergo a similar change. The result of

this process is the gradual liquefaction of the tumour and the formation of a cyst. The degeneration frequently commences at several separate foci, so that multiple cysts are formed. Sarcomata may also be the seat of fatty degeneration.

MIXED TUMOURS OF CONNECTIVE-TISSUE TYPE.—The whole of the connective-tissue tumours originate by the proliferation of connective-tissue cells. In any case where the tendency is for these cells simply to *multiply*, a sarcomatous tumour results; and where, in addition, no tendency whatever to *develop* into one of the adult forms of connective tissue is present, the tumour is composed simply of round cells—a round-celled sarcoma. The first evidence of development is seen in the elongation of the cells into spindles or ovals, and the production of a spindle-celled sarcoma. But in many tumours a further tendency to development is present; and, inasmuch as from connective-tissue cells any of the connective tissues may be built, the sarcoma cells become variously mingled with fibrous tissue, cartilage, bone, fat, &c. Supposing that the bulk of the tumour continues cellular, the name sarcoma is still retained, and an adjective, indicating the nature of the developed tissue is prefixed—e.g. fibro-sarcoma, chondro-sarcoma, &c. It is at this point that great difficulty often arises as to whether a growth is, from microscopical examination, to be considered innocent or malignant. For the fibro-sarcomas merge imperceptibly into the sarcomas on the one hand and the fibromas on the other; the chondro-sarcomas into the chondromas; the osteo-sarcomas into the osteomas, and so forth. From a microscopical point of view, it must be laid down that any tumour in which are collected masses of connective-tissue cells must be placed amongst the sarcomata, whilst those in which no such collections are present belong to the innocent class of connective-tissue tumours.

It may be well to describe briefly the general structure of the four most common forms of mixed growth:—

(1) **FIBRO-SARCOMA.**—This form of tumour generally belongs to the spindle-celled group, and was formerly described as 'recurrent fibroid.' The spindle cells are often large, and are mixed both with young connective-tissue and with broad bands of fully developed fibrous tissue.

(2) **MYXO-SARCOMA.**—In myxo-sarcoma the stroma of the tumour consists of branching cells enclosing spaces, in which is contained a clear mucous fluid. In these

spaces are also sarcoma cells. These growths gradually fade into the class of soft fibromas and true myxomas, and from these it is often difficult to separate them.

(3) **OSTEO-SARCOMA.**—This form of tumour occurs only in bone. It consists of a varying amount of sarcomatous cells, mingled with and enclosed by bone trabeculae. *See TUMOURS OF BONE.*

(4) **CHONDRO-SARCOMA.**—The cartilage met with in this form of growth may be either fibrous or hyaline; the sarcoma cells are either round or oval.

The naked-eye appearances of the sarcomata vary indefinitely. In shape, size, and outline no two are alike. On section, the sarcomas that are unmingled with other tissue may be soft, brain-like, and pulpy, readily breaking down on pressure; frequently they possess a gelatinous semi-translucent structure; frequently also they are of a red and fleshy appearance; in any case they may be more or less infiltrated with blood. In one respect they differ, however, from all other tumours—namely, in the homogeneous appearance of their cut section, for, in a typical sarcoma no appearance of fibrillation or of lobulation is to be found. Of course, in proportion as the sarcoma tissue is mingled with fibrous, cartilaginous, or other structures, so the appearance on section will differ. Again, where degenerative changes have been in progress, a variable amount of cystic degeneration, with varying degrees of consistence, will be found.

On section, the sarcomata often appear to be encapsuled, their edges being rounded and apparently well-defined. But although in some few cases they are contained in a pretty definite cyst-wall, in by far the majority of instances the appearance of a capsule is misleading, and, on attempting to separate the new growth from the surrounding tissues, they will be found almost inseparably blended. In other sarcomata, and these the most malignant and rapidly growing, there is no appearance of a capsule, and the tumour infiltrates the surrounding parts in an irregular fashion, being altogether inseparable from the tissues in which it grows.

To the naked eye the *hæmorrhagic sarcomata* often appear simply as hæmatomas, but if careful examination be made, their cyst-wall will almost invariably show evidence of new growth in some part of its circumference. They generally contain both fluid and clotted blood of a dark colour.

The *myeloid tumours* of bone have in part a red-brown or maroon colour (not

unlike that of the normal heart), which when present gives to them a very typical appearance. These growths often possess a pretty definite bony cyst-wall, from which they may easily be shelled out. They are very prone to undergo degenerative changes, so that the hollow formed by the expanded bone is frequently found filled with a broken-down pulp. In some cases, large vessels open into the cyst-like cavities thus formed and produce an evident pulsation, thus forming the so-called 'pulsating tumours of bone.'

The *periosteal sarcomas* of the long bones grow beneath, and strip up the periosteum; they infiltrate both it and the subjacent bone. The most superficial parts of them resemble the sarcomas as already described, but in their deeper portions they are usually completely ossified. They are never encapsuled. See TUMOURS OF BONE.

The *Localities* in which the sarcomata grow are very various. They may develop in almost any part of the body, for connective tissue is to be found in every organ and tissue to a greater or less extent. There are, nevertheless, certain situations in which sarcomata are more common than elsewhere.

The *round-celled* groups are found in the secreting glands—e.g. the testes, parotid, and sometimes the breast. That variety called 'alveolar' occurs chiefly in the skin; the melanotic variety in the skin and in the eyeball; the lympho-sarcomata in the lymphatic glands.

The *spindle-celled* sarcomata occur chiefly in the intermuscular fasciæ and subcutaneous tissues—as periosteal tumours of the long bones, especially of the femur and tibia; also in some of the glands, especially the breast and parotid.

The *mixed-celled* sarcomata are also found chiefly in the connective tissues of the extremities and in the periosteum of the long bones.

The *myeloid* tumours grow inside the long bones, which they tend to expand in their growth; they are found chiefly in the articular ends of the femur, tibia, and humerus. Apart from the long bones, myeloid growths are most commonly met with in the superior and inferior maxillæ.

The *gliomas* are found either in the eyeball or else in the brain and spinal cord.

The *hæmorrhagic sarcomas* occur almost invariably in the connective tissues of the extremities.

Of the various mixed tumours of connective-tissue type the *fibro-sarcomas* are the most common. They occur in the sub-

cutaneous tissues, in the periosteum of the long bones, and in the breast; they are the most usual form of sarcoma met with in the latter organ.

The *chondro-sarcomas* grow more particularly in the articular ends of the long bones, in the parotid, the testis, and very rarely in the breast.

The *osteosarcomas* grow in the bones, especially those of the extremities.

The *myxo-sarcomas* are found in the mucous cavities, such as the nose and antrum. They occur also in the uterus and in the parotid glands.

Clinical Characters of the Sarcomata. In speaking of the sarcomata in general, it is impossible to describe with anything like accuracy the special characters which appertain to the various tumours of this class, for they vary immensely according to their locality.

These growths may be said to occur more frequently in the young and middle-aged than in the old, to follow injuries with tolerable frequency, and to grow rapidly. The more malignant the tumour the more rapidly it grows. The amount of pain caused by such a growth necessarily varies greatly; frequently no pain or tenderness is complained of.

When in a situation favourable for examination, a sarcoma presents itself as an irregularly rounded or oval swelling, sometimes a little lobulated, but with a surface generally smooth, adherent to the parts amongst which it lies, and therefore more or less fixed, and firm, elastic, or semifluctuating to the touch. The more rapid the growth of the tumour, the more soft and fluctuating is it as a rule. It is usually very vascular, and attention is called to this by the enlarged and tortuous veins in its neighbourhood.

Of the varieties of the sarcomata the following points may be briefly noted:—

The *melanotic sarcomata* of the skin generally develop in the site of a previously existing mole or wart, sometimes when either of them has been irritated by caustics or by imperfect attempts at removal. Rapid growth in a mole or wart, previously quiescent, should then always be looked upon with great suspicion, and radical treatment never delayed. In the later stages of melanotic sarcoma multiple growths are common, and pigment-granules may be found in the urine.

The *hæmorrhagic sarcomata* are rapidly forming tumours, evidently fluctuating, situated generally on one or other extremity, with no signs of inflammation, and,

when tapped, yielding usually dark-coloured blood. They rapidly refill after tapping, and continue to increase in size—a point to be noticed, for simple hæmatomas do not increase unless they become the seat of suppurative changes.

The *sarcomas of bone* grow almost invariably at the articular ends of the long bones and in the bones of the face. The myeloid growths, commencing within the cancellous tissue, expand the bone in their growth, and so become covered by merely a thin shell which, on pressure, is readily indented, with a crackling sensation. This bony crackling is never present in the subperiosteal sarcomas. Occasionally, also, the central tumours of bone are the seat of distinct pulsation, caused by the opening of large vessels into the cysts formed by degeneration of the tumour-mass.

The *periosteal sarcomas* are more rapid in their growth than the endosteal; they grow on one aspect of the bone, and do not pulsate. Neither the central nor the periosteal growths often cause glandular affection. See TUMOURS OF BONE.

Signs of Degeneration in Sarcomata.—As already described, the sarcomata may undergo degenerative changes, resulting in the formation of cysts containing fluid within the tumour-mass. These collections of fluid necessarily yield a distinct sense of fluctuation, and those parts also which are yet in the process of degeneration, but which, though succulent, are not yet fluid, feel in a corresponding degree softer than the rest of the sarcomatous growth. Thus, in a sarcoma that is degenerating, the whole mass varies in consistency at different points.

Signs of Inflammation in the Sarcomata.—Although, as a rule, the sarcomata grow without any definite signs of inflammation, it must nevertheless be remembered that, very rarely, not only may such tumours show all the local signs of inflammation, but that pus may be formed within the new growth itself, and the abscess may come to the surface and burst, in a manner which differs in no way from that which pertains to simple abscess situated amidst the tissues of the body. So, pain, redness, heat, and swelling are all compatible with the presence of a sarcoma, and, yet further, the temperature may be raised and may continue at 101° or 102° F. for many days, even when there is no suppuration.

Differential Diagnosis of the Sarcomata.—It is not possible in the present article to deal at all fully with the differential diagnosis of the sarcomata; all

that is therefore attempted is to point out the chief only of those swellings which may be mistaken for the sarcomas.

To facilitate this, the writers suggest that the tumours in question should be considered according as they are found—A. In the soft connective tissues. B. In the glands. C. In the bones.

A. *In the soft connective tissues* the sarcomata must be especially distinguished from—1. Cysts. 2. Abscesses. 3. Hæmatomas. 4. Syphilitic swellings. 5. Innocent tumours.

1. *Simple or serous Cysts.*—The locality of the swelling may be such as to make it highly improbable that it is cystic. The growth may have been more rapid than is usual in cysts. If large and superficial, cysts are often translucent—sarcomas never. If tapped with an aspirator or fine trocar, a simple cyst will be entirely emptied and its contained fluid will be found clear and serous. If a solid sarcoma be tapped, only bright blood will escape; if one that is undergoing cystic degeneration, the fluid that is drawn off will be dark and blood-stained, and, when it has ceased to flow, some of the swelling will still remain and can be felt to be solid. Fluctuation is much more marked in a cyst, and is readily transmitted from its extreme boundaries. This is not usual in sarcomas, even in those that are undergoing cystic degeneration.

2. *Abscesses* which are chronic and deeply seated may simulate sarcomas very closely, but some of the signs of inflammation will generally be present, and often there is, if nothing else, a little cedema of the superjacent skin. On the other hand, a sarcoma that is inflamed may closely simulate an abscess. In many cases, tapping alone will clear up the diagnosis.

3. *Hæmatomas*, as already mentioned, may closely simulate or be simulated by the hæmorrhagic sarcomas. The rapidity of growth, the rapid refilling after tapping, and the increase in size, independently of any inflammatory changes, will usually serve to distinguish this variety of sarcoma. For it must be remembered that tapping alone will not decide the question, the dark-coloured bloody fluid answering equally well for the contents of either a hæmorrhagic sarcoma or a hæmatoma, and the size being as much reduced in the one as in the other. The latter swellings, however, do not rapidly increase in size unless they become the seat of suppuration.

4. The diagnosis from *Syphilitic Gummata* is sometimes very difficult, and often at first impossible; for although other evi-

dence of syphilis in the same individual will make the diagnosis of gumma probable, it will not necessarily disprove the sarcomatous nature of the growth. As a rule, a decision will be most readily arrived at by placing the patient under antisyphilitic treatment.

5. *From Innocent Tumours.*—The lipomata and soft fibromata are the innocent tumours which, to the touch, most resemble sarcoma, but it is chiefly when growing in unusual situations or existing under unusual conditions, such as being injured, inflamed, &c., that any difficulty of diagnosis arises. A satisfactory conclusion will generally be arrived at by a careful comparison of the physical characters of the sarcomata with those of the innocent tumours. But the rapidity of the growth is the most essential particular into which inquiry should be made, the increase in size of the malignant tumours being very much more rapid than that of the innocent one.

Nævoid growths also may simulate sarcomata. Their congenital occurrence and great vascularity, combined with the fact that their size may be diminished on pressure, will generally, but not always, serve to distinguish them. In cases of large subcutaneous nævi the diagnosis may be very difficult.

B. *In the Secreting Glands.*—In the breast, parotid, and testis more particularly, the sarcomata have to be diagnosed from—1. Carcinomata. 2. Tumours of an innocent nature. 3. Cysts and abscesses.

1. From the *Carcinomata* the sarcomas may be distinguished, in most cases, by attention to the descriptions already given of the clinical characters of these growths. See CARCINOMA. Diagnosis is not of material importance, for the treatment of each class of tumours is alike. Carcinomas are rare in the parotid, sarcomas common.

2. From *Innocent Tumours* the diagnosis may be made by attention to the rapidity of growth, the infiltration of the tissues, and the affection of the general health, as well as by the physical characters of the growth itself.

Such special swellings as hæmatocele and chronic orchitis are considered elsewhere. A tumour of long duration must not be judged innocent from that fact alone. For, though of slow growth and apparently innocent, it may after some years begin to grow rapidly and exhibit all the signs of malignancy.

3. From *Abscesses and Cysts* the diagnosis may be made in a similar manner to that already described in dealing with sar-

comas of the soft connective-tissues, bearing in mind, in the case of abscesses, any points of special history which may belong to the part of the body affected—e.g. history of recent parturition and lactation in the case of the mammary gland, of urethral inflammation in the case of the testis, &c.

C. *In the Bones.*—In the bones the sarcomas are chiefly simulated by or else simulate—1. Joint-disease. 2. Quiet necrosis without suppuration. 3. Chronic periostitis.

1. From *Joint-disease* the sarcomata may be diagnosed by the healthy condition of the patient, by the rapid increase in size of the swelling, the enlarged and tortuous veins on the surface, by bulging more on one side of the articulation than another, by the frequently painless, though limited, movement of the joint itself, by the evident implication of one bone greatly in excess of the other, by the absence of inflammation and of starting pain at night, and by the failure of all treatment. It must be clearly remembered that the joint may itself become diseased by the encroachment of the tumour. In these cases of sarcoma signs of inflammation are often well-marked, and great care is frequently necessary to establish a diagnosis.

When the tumour grows from the centre of the bone, and more particularly when of the myeloid variety, the presence of 'egg-shell' crackling, and occasionally of pulsation, will show clearly the nature of the swelling.

2 and 3. *Swellings on bones the result of quiet necrosis* or else of *simple or syphilitic chronic periostitis* may be considered together. In many cases no difficulty arises in separating such inflammatory swellings from the sarcomata of bone, but, in those instances in which the inflammatory symptoms are but little marked, the diagnosis may be so difficult that, without incising the swelling, it is not possible to be certain of its nature. It is well to bear in mind, in considering such a case, that the sarcomata almost invariably grow at the epiphysal ends of the bones, so that any tumour situated on the shaft is not likely to be sarcomatous. Moreover, in cases where the swelling is due to periostitis, its shape is suggestive rather of enlargement of the bone, with preservation of the general outline, than of a tumour presenting on one aspect alone; whilst, to the touch, the sarcomatous growth is not hard and incompressible in its whole extent, but in parts is often soft and elastic. Reliance must not be too strongly placed on an increase or

abnormally wide variation of the body temperature, for in the sarcomata of bone such increase and variation may be present, and the temperature chart may be indistinguishable from that of hectic fever. Again, if the swelling be due to chronic periostitis, treatment by counter-irritants and absorbents, especially iodide of potassium will often result in its disappearance; though, if quiet necrosis be at the bottom of the inflammation, this disappearance will not take place. In all doubtful cases an exploratory incision should not be too long delayed. And even after such incision has been made the diagnosis is not always easy, for the thickened and inflamed soft tissues around the dead bone may closely resemble sarcoma.

For *Etiology; Clinical differences between Malignant and innocent tumours; and for Treatment of the sarcomata*, see MALIGNANT TUMOURS.

W. MORRANT BAKER.
ANTHONY A. BOWLBY.

SAYRE'S SPLINT for the hip consists of a metal bar, which reaches, as an outside thigh-splint, from the pelvis to the knee. This bar is composed of two pieces, one of which slides within the other and is capable of being fixed, as required, by a ratchet. The upper end of this bar is connected, by means of a ball-and-socket joint, to a padded metal band, which is meant to encircle the pelvis; from the lower end of the bar two arches pass off with sufficient span to reach over the front of the thigh to the inner side of it, where they become continuous with a short longitudinal bar. At the lower end of both the outer and inner longitudinal bars there is a pulley, and just above the latter there is a buckle. There is also a perineal band which, when the splint is applied, is buckled in front and behind to the pelvic girdle. To apply the splint, two pieces of strapping, with a piece of webbing stitched to one end of each, should be fixed to the inner and outer surfaces of the thigh by another piece wound spirally round the limb, and by a few turns of bandage placed over all. The pelvic girdle and perineal band should next be adjusted, the metal bar being placed in position along the outer side of the limb; and then the pieces of webbing, above mentioned, should be carried round the pulleys at the lower end of the splint, and fastened up tightly to the buckles. By turning a key the splint can be lengthened, and as the thigh is fixed by the strapping to the lower end of the splint, and as the perineal band

will check upward displacement of the pelvic girdle, the lengthening of the splint will cause extension at the hip-joint. See HIP-DISEASE. BILTON POLLARD.

SCABIES, or the ITCH.—*Definition.*—A contagious disease of the skin, due to the presence of a small mite known as the *Acarus scabiei*. See *Acarus Scabiei*, under ACARUS.

Course and Symptoms.—The female acarus penetrates and burrows into the substance of the epidermis, and oftentimes into the hair-follicles. In this burrow or cuniculus, which in the early stages is not well-marked, and in cleanly people is difficult of detection, the female, being unable to retreat by reason of certain projections or spines with which its body is armed, lives, lays eggs, and dies; the male, on the other hand, lives on the surface of the skin, some say in the shallower burrows. The lesions produced depend upon the depth of penetration of the acarus and the susceptibility of the individual attacked. The earliest signs are the formation of minute inflammatory macules, papules, and vesicles. The sympathetic irritation is very considerable, extending to parts far removed from the seat of the acarus or acari. If neglected, the disease spreads daily, until at the end of three or four weeks all the characteristic parts have become affected. The position of the burrow is beneath the horny layer of the epidermis and in the upper part of the rete. The burrow is slightly raised and very tortuous, and its average length is one-fifth of an inch, but occasionally it reaches the length of two or even three inches. In appearance it is of a whitish or yellow colour, and, seen through a glass, is either dotted from ova and excreta or black from dirt. A vesicle is often formed at the point of entrance to the burrow, at the other end of which will be found the acarus. As a rule, burrows are only to be discovered between the fingers and toes, on the wrists, and on the navel and penis; and even on these parts they may be completely destroyed by scratching, or obscured by much pustular eruption and scabs. To remove an acarus, it is necessary to place a needle flat upon the surface of the skin—and not perpendicularly—the point is then inserted into the burrow at right angles to its course, and on slowly moving it away from the vesicular end, the acarus, if alive, will adhere to the needle.

The eruption, which is of an eczematous character, is always accompanied by much

itching at night, produced by the warmth of the bedclothes. Papules, vesicles, and pustules may all be present at the same time. The papules are usually numerous, always small, and, according to Dr. Liveing, generally more isolated and scattered than those of simple eczema, and do not early develop into large excoriated patches. The vesicles are of various shapes and sizes, usually have inflamed bases, and often show parts of burrows on their summits, in which condition they may remain or, passing into pustules, increase to a considerable size and extend. The disease usually begins on the hands, especially between the fingers, whence it is commonly communicated to the penis in urination. In women, it attacks the mammae about the region of the nipple, and in all cases shows a preference for the softer regions of the trunk, especially the warmer parts, and also the inner surfaces of the limbs. In adults, the disease is never found either on the scalp or face—those parts being much exposed to cold—and only occasionally in infants. In young children, the buttocks and feet are often affected. It displays a preference for those parts of the skin which are subject to any pressure, as, for instance, beneath the stays, garters, or belt, and upon the buttocks of people who sit much. Scratching produces important secondary lesions—excoriations, torn papules, vesicles, and pustules—which result in crusts of blood, serum, and pus, and also general dermatitis, with infiltration, thickening, and pigmentation. Irritation is not always confined to the immediate neighbourhood of the acari, and the sympathetic itching caused by them, in distant parts, accounts for the widespread eruption apparently so out of proportion to the cause. Cases of so-called Norwegian scabies—which is a more serious, exaggerated, and chronic form, or an advanced stage of the same disease, resulting from neglect—have been known to last a lifetime. The whole integument becomes chronically inflamed and covered with pustules and extensive crusts, in which numerous acari and ova are found.

Diagnosis.—The only diseases with which scabies can be confounded are eczema and prurigo, and the following are the exact points which distinguish it from them:—The position of the eruption; the time and amount of irritation; the presence of burrows and acari; and the history of contagion. In scabies, the eruption is limited to certain parts—between the fingers or toes, fronts of wrists; while in eczema the erup-

tion spreads from the margin of the patches, and is never limited to these parts. In prurigo the hands are only slightly affected—usually only when there is secondary eczema—the characteristic parts attacked being the front and back of the trunk and the extensor surfaces of the limbs. The irritation in scabies is always worse when the skin is warm, but as this is also the case to a modified extent in both eczema and prurigo, the other points are the only certain signs whereby scabies may be distinguished from the two diseases mentioned.

Treatment.—This consists in the complete destruction of the acari and their ova. But, in order to do this effectively, it is necessary to open up the burrows in which they are concealed. This part of the treatment is at times rendered somewhat difficult by reason of the secondary eczema. The body should be soaked in a hot bath, after which all parts, where burrows are known to exist, should be freely rubbed with soft soap and a brush, and the entire surface then covered with an ointment containing some parasiticide. In this way the scabs will be removed, the burrows will be torn open, and the acari and their ova destroyed. After the process has been repeated once or twice, according to circumstances, the disease itself will be cured, although some eczema may remain as the result either of the disease or of the treatment. The effect of all parasiticides is more or less irritating, and as some people suffer much from them, care must be taken in their selection.

The two essentials in the treatment—that is to say, the opening up of the burrows and the destruction of the acari and ova—can be combined in one remedy, the lotion known as Vlemingx's solution, \mathcal{R} Calcis \mathfrak{z} ss., Sulph. precip. \mathfrak{z} j., Aq. destill. \mathfrak{t} zv. This, rubbed in forcibly for half an hour and followed by a hot bath with plenty of soap, will often effect an immediate cure. But it is a rough method, and should only be used when time is a great object. A milder plan, and one almost as rapid in its results, is to combine the soft soap with the parasiticide, as in Hebra's modification of Wilkinson's ointment—Sulph. præcip. et picis liq. $\mathfrak{a}\mathfrak{a}$ \mathfrak{z} vj.; Saponis viridis et adipis $\mathfrak{a}\mathfrak{a}$ lb. j.; Cretæ \mathfrak{z} iv. Fiat unguentum.

The sulphur vapour bath is recommended by some authorities, but it is far less effectual than ointments. If the sulphur ointment of the B.P. be employed, it should be reduced to, at any rate, one-third its strength. It is necessary to remark

that the antiparasitic remedies should be discontinued as soon as possible, and that the subsequent eczema should be treated with soothing powders, lotions, or ointments. It is also important to note that the underclothes worn by the patient should be baked in an oven, so that all ova may be destroyed.

The following applications are all most useful for the destruction of the acari:—

R. Olei cadini et sulph. præcip. āā ʒiij.; Glycerini amyli fʒvj.; Adipis benzoati ad ʒiij.

R. Styracis liquidi fʒj.; Adipis ʒij.

R. Styracis liquidi fʒj.; Sp. vini rect. fʒij.; Ol. olivæ fʒj. Fiat linimentum.

R. Pulv. staphisagriæ ʒj.; Adipis ʒiij.

R. Balsami Peruviani ʒss. vel ʒj.; Adipis ʒj. Suitable when for some special reason sulphur is not advisable.

R. Naphthol. fʒss.; Adipis ʒj.

It is quite unnecessary to employ any internal treatment in Scabies.

MALCOLM MORRIS.

SCALDS. See BURNS.

SCALDS OF THE GLOTTIS are most commonly met with in infants or young children, from attempting to drink out of the spout of a kettle; or else in adults from the inhalation of steam in boiler accidents, or of ignited gas in explosions. In the latter, the lips and face, and even the whole body, are involved; in the former, the scalding steam is drawn into the interior of the larynx, and even into the trachea, by the sudden inspiration which precedes the cry of pain caused by the contact of the boiling water.

The severity of the injury presents considerable variations in each case. The mouth itself may escape so completely that, on casual inspection, there is nothing serious visible, while in reality the edges of the epiglottis are scorched and shrivelled, and the upper and back part of the larynx swollen and blistered; or the lips and tongue may be reddened and covered with vesicles full of exuded lymph, or with shreds of yellowish epithelium hanging down from the swollen papillæ. Sometimes, there is merely a slight degree of hyperæmia; at others, particularly if the fluid has entered the mouth, the epithelium is raised up and detached just as in scalds of the skin.

The symptoms are immediate, due to the injury itself, or remote, consequent on the inflammation that always ensues. Severe burning pain is always present: in

a child the screaming is incessant until, partly from exhaustion, partly from the oedema which very rapidly sets in wherever there is any loose connective tissue, the voice fails completely, and there is nothing to be heard but a hoarse, croupy inspiration. Often, the child tries to thrust its hand into its mouth or clutches wildly at its throat. Great restlessness and anxiety, or a continual sense of impending suffocation, are always present. Difficulty of swallowing sets in from the first; dyspnoea may also be immediate, but more often it becomes more marked in the course of a few hours, in consequence of the oedema and inflammation.

Exudation and swelling follow rapidly—most marked, of course, in the submucous tissue of the injured part, and particularly where the fibres are loose and yielding. By the root of the tongue, round the base of the epiglottis, and along the course of the folds leading from its sides to the arytenoid cartilages, are the favourite places. The ventricles are rarely much involved, and the true vocal cords, where there is no submucous tissue, hardly ever. The epiglottis itself may appear hard and shrivelled; the folds behind it are swollen up so that they can easily be felt with the finger, or seen, when the tongue is depressed, as smooth, round, semi-translucent masses on either side, reaching nearly across the middle line. Below, in the lower part of the larynx and trachea, similar changes, though of less severity, are not uncommon; probably due to the direct effect of the injury, although perhaps in some instances the result of extension of the inflammation. In short, the appearances are those of acute laryngitis, with more or less oedema of the glottis.

As this stage is reached, generally some few hours after the accident, and often preceded by a period of delusive repose, the symptoms become more and more grave. The dyspnoea, especially, increases slowly and surely, becoming worse the whole time, but interrupted now and then by paroxysmal attacks of asphyxia, each of which seems as if it would prove instantly fatal. Inspiration is much more impeded than expiration, especially in children; the breathing has a hoarse, croupy sound; the voice is completely lost; and with its chest thrown forwards and its chin upwards, so as to secure the greatest muscular aid, the child sits propped up, perfectly quiet, with its whole energy directed to its respiration. The face is pale and cyanosed, the lips dusky, the skin bedewed with perspiration, the pupils dilated, and all the symptoms of

asphyxia are present. At length the child sinks into a state of collapse, or death takes place suddenly during one of the paroxysms.

Later on, if this stage does not prove fatal, inflammatory affections of the bronchi and lungs ensue. The temperature rises, all the signs of fever set in, and a low insidious form of broncho-pneumonia makes its appearance—peculiarly dangerous not only in itself, but also from the circumstances which have preceded it, and the conditions under which it appears.

The *prognosis* is at all times exceedingly grave. The case may sometimes terminate fatally at once, from the shock of the injury. More often the symptoms subside for a short time, and then, especially at night, break out again with a succession of paroxysms, any one of which may be the last; and when this stage has passed, owing to the inflammation that follows, convalescence is always protracted and tedious.

Treatment.—The first object is to confine the inflammation following the injury within the narrowest possible limits, so that there may be free entry for the air, and that the lungs may not collapse or become involved by gradual extension of the mischief. Then, every care must be taken to prevent the access of anything that could irritate the larynx. The mucous membrane becomes intensely sensitive when it is inflamed, and what would hardly be noticed under ordinary conditions, or at most would give rise to a transient cough, may now excite such a paroxysm of spasmodic contraction that death ensues before any relief can be afforded. Finally, there is the question of tracheotomy, or, in children, of laryngo-tracheotomy, either as a preventive measure or to relieve already existing obstruction.

The temperature of the air breathed must be perfectly equable, and it ought to be saturated with moisture. This is best managed by surrounding the cot with curtains, and conducting the steam of a kettle into one corner; in this way cold draughts and dusty air may be completely excluded, but care must be taken not to raise the temperature too high, so as to avoid the intense depression caused by a warm moist atmosphere. Perfect rest is essential; but, as a rule, if the difficulty of breathing is at all great, the patient will remain perfectly quiet of himself. Ice round the neck, applied by means of a collar, and the continual sucking of small fragments, retaining them as long as possible in contact with the fauces, will help to keep the hyperæmia in check and to diminish the sensitiveness.

Bromide of potassium has been recommended for this purpose, but as a rule the symptoms come on before the drug has time to act. Leeches applied to the sternum or at the lower part of the neck, purgatives, and emetics—especially those which act like alum, without leaving behind any lasting depression—are of the greatest service in mild cases. Aconite and antimony are of use occasionally when there is a considerable rise of temperature, and small doses of calomel, gr. j. to gr. ij. every hour, until there are free bilious evacuations, enjoy a high reputation.

If, in spite of treatment, the dyspnoea continues to increase, and if, without there being any marked spasmodic attack, inspiration is becoming more difficult and the chest-walls are falling in, the choice will lie between free scarification of the swollen parts of the larynx, so as to procure the evacuation of as much exudation as possible, or opening the windpipe lower down. The former operation, particularly when the most swollen parts are the ary-epiglottic folds, which is usually the case, may be accomplished without much difficulty, either by means of an instrument devised for the purpose or with an ordinary sharp-pointed bistoury, of which all but the half-inch nearest the point has been guarded by a spirally wound piece of strapping. The folds can easily be felt with the forefinger of the left hand, and free incisions may be made on their upper surface. With reasonable care there is no danger of wounding any important structure, and it is surprising both how little of the exudation comes from a comparatively large wound, and how small that wound becomes when the part resumes its normal dimensions. The chief difficulty arises from the degree of dyspnoea from which the patient is already suffering, and from the spasmodic contraction sometimes induced when the finger touches the larynx.

It is best to postpone tracheotomy as long as possible, but it must not be forgotten that spasmodic contraction may come on with the slightest cause, even on movement, when a larynx is inflamed, and that any of these attacks may prove fatal. The operation gives, it is true, protection from one of the great dangers of this accident, and helps also to prevent collapse of the lung and subsequent hepatisation; but in a child it is a matter of some gravity, and it adds an additional cause for the inflammation of the bronchi and lungs which so commonly follows. But if tracheotomy is reserved to the last, and performed only in cases that are almost desperate, the ill

result must not be laid entirely to the credit of the operation. In all probability, if it were done at an earlier period and in a larger number of cases, instead of being reserved for those in which inflammation has already set in, and probably extended into the bronchi, the results would be very different. In any case it is advisable to insert a soft india-rubber tube as early as possible, so as to avoid the ulceration of the mucous membrane and necrosis of the cartilages, not uncommonly seen after the introduction of metal ones.

C. MANSELL MOULLIN.

SCALP, Injuries and Diseases of the. The skin covering the cranial vault is intimately connected, by means of strong fibrofatty tissue, with the tendon of the occipitofrontalis. These three structures constitute the scalp, whose inner surface, formed by the smooth aponeurosis of the muscle, is attached to the pericranium by loose areolar tissue and small vessels, and is freely movable over it.

HÆMATOMA, or a fluid blood-tumour of the scalp, is often the result of a blow. These tumours are situated either beneath the skin, beneath the aponeurosis, or beneath the pericranium. If blood collects between the skin and the aponeurosis, its amount must be very limited, as the tissue here is unyielding; but if it is poured out beneath the aponeurosis, the extravasation may be very extensive—sufficient indeed to lift the scalp away from the pericranium. It is limited in front and behind by the attachments of the occipito-frontalis, whilst laterally it descends as low as the zygoma, for the lateral edge of the tendon is continued to that bony process by a thin membrane which lies superficial to, but not in immediate relation with, the temporal fascia. Fortunately, the vessels in the subaponeurotic space are small, or this accident would be far from rare. A blood-collection which involves the separation of the pericranium from the skull is known as a **CEPHALHÆMATOMA**, and is necessarily limited to one bone by the dipping in of the pericranium at the sutures. It occurs commonly over the right parietal bone during parturition, or may follow a blow in an infant.

The *treatment* of blood-extravasation of the scalp should be conducted on those general principles which guide the surgeon in the management of hæmatomata occurring in other parts of the body. It should be mainly expectant, for, unless these collections are very extensive, the hope may be indulged in that they will clear up under

the influence of evaporating lotions, and an arrest of the movement of the scalp by means of strapping carefully applied. If these measures fail, antiseptic aspiration may be tried; but if any septic or inflammatory change occur within the tumour, free incision at dependent points must at once be practised, and the whole cavity washed out with some efficient antiseptic agent. Free drainage must then be provided for, and the dressing should be either gauze or wood-wool, impregnated with carbolic acid, iodoform, or corrosive sublimate. Shaving of the head is necessary, if the blood-extravasation be extensive and complete antiseptics be attempted.

WOUNDS OF THE SCALP partake of the same characters which distinguish wounds of other superficial regions. The incised, lacerated, and contused varieties are the most common. They are peculiar in the facts that they do not gape, and that, even if small, they may give rise to a good deal of bleeding, because the arteries lie in the subcutaneous fibrous tissue and are unable to either contract or retract—partly in consequence of the rigidity of this tissue, and partly as a result of the attachment of their outer coats to it. The partial division of vessels is another potent cause of profuse hemorrhage from the scalp. This hemorrhage can always be easily controlled by pressure. The bandages should be carefully applied without undue force, as more than one case has been reported in which a scalp bandage has produced sloughing of the cranial coverings. The hairs of the scalp are so strongly attached that cases are on record in which the scalp had been torn off by force conveyed through the hairs—the latter collectively possessing very considerable strength. Large portions, or even the whole, of the scalp may be stripped off from the vault of the skull without losing vitality, since the scalp carries its blood-supply with it, its arteries lying between the various layers of tissue of which it is composed. The danger of scalp wounds is coincident with and is chiefly caused by the opening up of the subaponeurotic space, the spread of inflammation being so easy in the loose areolar structure which intervenes between the tendon and the pericranium. If the bone is exposed by the stripping up of the pericranium it does not necessarily follow that it will necrose, as it is in most part nourished by the endosteal vessels. It is, however, undoubtedly a fact that the most common cause of intracranial inflammation is injury to the scalp, with stripping up of the pericranium.

Another noteworthy point about injury to the scalp, with exposure or bruising of bone, is that, should unhealthy inflammation ensue, the emissary veins may be the carriers of septic products into those of the diploë, or into the sinuses within the cranium. In either case a fatal pyæmia, preceded by thrombosis and osteitis, is likely to supervene.

Treatment.—Absolute cleanliness and antiseptics are of the first importance in the management of all scalp-wounds. If a large portion of scalp has been stripped off the cranium, infinite pains should be taken to make the whole aseptic by removing the hair and by diligent washing. The torn edges can then be united by sutures, counter-openings being made at dependent points, through which drainage-tubes should be inserted, and over all a carbolic gauze and salicylic wool dressing be accurately adjusted. Thus treated, cases oftentimes apparently the most severe convalesce, especially if the patient be young, with great rapidity. Wounds which do not pass through the occipito-frontalis tendon heal rapidly without any special treatment. Scabs are, however, apt to form over these trivial wounds, and it is necessary therefore to be careful that no wound-secretion remains pent up. Injuries of the scalp are especially dangerous in those cases in which other injuries would be serious, as in patients suffering from alcoholism or albuminuria, or the subjects of hæmophilia. In patients who are sodden with alcohol, delirium tremens, or a low form of inflammation accompanied by a low, muttering delirium, may ensue, which it will tax to the utmost the powers of the surgeon to subdue. In albuminuria, an asthenic form of inflammation is apt to come on which heralds a fatal issue. In hæmophilia, the wounds are best left entirely alone, exposed to the air without any interference. The only treatment which the writer has seen successfully adopted in such cases is the local application and internal administration of turpentine.

After all bad scalp-injuries the patient should be kept at rest for some days, the primæ viæ should be put in order, and the diet should be unstimulating, moderate in quantity, and largely composed of milk and foods made with milk.

INFLAMMATION readily occurs about a wound of the scalp if any secretion be pent up, or if asepsis be not attained. Shaving, free drainage, and poulticing will prevent its extension in most cases. It has, however, a tendency to assume an erysipelatous form, and then the whole scalp may become

'boggy,' and the course of the case will not be so simple. Much redness and swelling are not possible, on account of the anatomical peculiarities of the tissue. Inflammation is most serious when the sub-aponeurotic space is opened, or when the bone is laid bare by the stripping up of the pericranium.

Erysipelas of the Scalp usually follows a wound and may be caused either by the conveyance of infection from another patient, through the air, or by means of tainted sponges, instruments, &c., or may arise *de novo* under conditions which were apparently the least likely to produce it. The early diagnosis between local inflammation, with formation of pus underneath the scalp, and an attack of erysipelas, is in some instances difficult. In the former case the inflammatory focus would be more or less limited and defined, and must have been preceded by local injury. The pus would, moreover (if formed), bag at the dependent and attached borders of the scalp. In the latter case the general constitutional symptoms would probably be more marked, and, at the very commencement of the attack, vomiting and enlargement of the cervical glands would be important points to note. *Cutaneous erysipelas* of the scalp commonly extends to the face, and can usually be with ease subdued by frequently changed warm compresses of lead lotion and by nutritious diet. The temperature may range up to 102° or 103° Fahr., and for two or three nights the patient may suffer from a little delirium. In those cases in which the whole thickness of the scalp is involved and the bone is bare, we have to deal with a *cellulitis* which is extremely dangerous; but, even in the worst cases, free incisions, antiseptic washings, ample diet, perchloride of iron and quinine, with stimulants, will do a great deal to bring about recovery.

Abscess of the scalp is small and unimportant if situated above the aponeurosis, and commonly happens from the scabbing over of a wound before the deeper parts are healed. If pus forms beneath the aponeurosis, the collection may be very extensive and serious. The treatment consists in shaving, free incision at dependent points—above the zygoma, at the upper margin of the orbits or in the occipital region—with antiseptic irrigation and dressings. The *sinuses* which remain after a large abscess of the scalp has been evacuated are sometimes difficult to close. The best way is to adopt Mr. Hilton's plan of securing rest to the scalp by well-applied strapping. *Abscess in the temporal fossa* may be

mentioned in this place. The pus tends to pass down beneath the zygoma, and does not point above it in consequence of the extreme density and strength of the temporal fascia. It should be opened above the zygoma as soon as deep fluctuation can be felt.

Boils and carbuncles occur upon the scalp. A carbuncle in this region may be most serious. It may commence in the soft parts covering the skull or extend to them after first attacking neighbouring parts, such as the back of the neck. See BOILS; CARBUNCLE.

SIMPLE AND MALIGNANT TUMOURS are by no means uncommon on the scalp.

Sebaceous cyst is the most usual form of simple tumour. If congenital, it is known by the name of *dermoid cyst*, occurs frequently near the outer angle of the orbit, and often involves the wall of the cranium. When placed in the median line, the diagnosis from meningocele is almost impossible. See MENINGOCELE. Sebaceous cysts, which are not of congenital origin, occur at any age after puberty, but most frequently in middle life. They may be multiple, and by their gradual increase in size during many years may, in rare cases, involve the cranial vault. The orifice of the obstructed follicle is generally visible, and the tumour itself is round or oval, tense, freely movable, hard, or fluctuating. These cysts can be removed by dissection, or by transfixion and subsequent avulsion of the wall of the sac. No part of the latter must be left, or troublesome after-consequences will ensue. These operations should never be lightly undertaken, and never except in persons in perfect health. The removal of a congenital cyst is more difficult, partly on account of its greater depth from the surface, and in part on account of the thinness and delicacy of the cyst-wall, and the adhesion of the latter to the bone. When a sebaceous cyst ulcerates, the diagnosis from epithelioma is not easy. The base of the ulcerated cyst is movable and not very hard; the granulations exuberant, and there is no evidence of surface-decay; the discharge is offensive, and the glands in the neck might be enlarged. See SEBACEOUS CYSTS.

Epithelioma generally commences as a crack or pimple, and there would be no history of a previous cyst. The base would be hard and fixed, and if at certain points vegetative outgrowths were apparent, the general tendency would exhibit an eroding and destructive character. *Rodent ulcer* not infrequently attacks the scalp primarily,

but it may do so secondarily after destroying a portion of the face. See under CARCINOMA; ULCERS.

The *treatment* of epithelioma and rodent cancer is wide excision. An ulcerated sebaceous cyst must also be excised. In epithelioma the glands in the neck may be implicated so much, by the time the patient is seen, as to make operation unjustifiable. In rodent cancer, the disease must be removed, even if it extends into the bone; and at the close of such an operation, the application of chloride of zinc paste is most useful.

Syphilitic ulceration of the scalp is occasionally most intractable.

The *pachydermatous tumour* of the scalp is very rare. It is a localised fibrous change affecting the skin and deeper tissues. It is movable, and causes much deformity. It has been successfully removed by the knife, but it is best for the surgeon not to interfere. When *multiple subcutaneous fibrous tumours* are found upon a patient, one of them may be discovered beneath the skin of the scalp. Outgrowths from the skull, such as *exostoses* and *nodes*, must not be mistaken for scalp-diseases.

For *Nævus* of the scalp, see NÆVUS.

PULSATING TUMOURS OF THE SCALP.

1. *Aneurism* of a scalp-artery takes place after some injury—usually partial division of a vessel. It is rare, has the typical signs of aneurism, varies from the size of a pea to that of a bean, and can be cured by either pressure or excision.

2. The common seat of *cirsoid aneurism* is the scalp. It is formed by a congeries of dilated vessels, which pulsate with a loud systolic bruit. The skin over the tumour is hotter and thinner than elsewhere, and the unaltered cranial vault can be palpated through the worm-like mass of the tumour. See CIRROID ANEURISM.

3. *Hernia cerebri*. See BRAIN, Hernia of the.

4. *Encephalocele*. See MENINGOCELE.

5. *Sarcomata of the dura mater or cranium*, if rapidly growing, pulsate. The pulsation is not affected by compression of the arteries of the scalp, and pressure upon the tumour does not produce cerebral symptoms. The tumour is perfectly fixed, and evidently attached to or continuous with the bone. Egg-shell crackling may be present. The diagnosis can rarely be made at such an early period as to justify operative measures.

6. *Pulsating hæmatoma* containing cerebro-spinal fluid as well as blood. For a description of this form of pulsating tumour, see MENINGOCELE.

For cutaneous and parasitic affections of the scalp, *see* TINEA TONSURANS; PEDICULI; HORNS. CHARLES A. BALLANCE.

SCALPELS are small knives which are used for most surgical operations requiring dissection. There are three patterns of scalpels, which differ from one another slightly in the way the point is made. The common operating scalpel is sharpened on one edge only, and both edges are rounded off towards the point, so that the latter is in a line with the middle of the blade. In another pattern, the back of the scalpel is sharpened for about half an inch near the point; in a third, the cutting edge only is rounded off, and the back of the scalpel runs straight on into the point.

SCAPULA, Diseases of the.—A large variety of tumours is found connected with the scapula. By far the greater number start from the bone itself, and gradually involve the entire scapula, the muscles and soft structures attached to it, the shoulder-joint and clavicle, and are malignant. The ordinary growths, met with in other regions, present the same characters here as elsewhere.

FIBROMATA spring from the muscular or fascial tissues covering the scapula; they are firm in texture, slow of growth, generally lobulated, circumscribed and encapsuled, not often painful, and when removed, as a rule, do not return.

SARCOMATA.—These growths are either parosteal, in the tissues superficial to the bone, periosteal, or central, in their origin; the last form generally occurring in the medullary structure of the neck of the scapula, whilst the first two are usually associated with the body or borders of the bone. The diagnosis between the parosteal and periosteal forms is scarcely possible, as the former often so closely invest the bone that the mobility of the tumour underneath the muscles of the scapula is difficult to detect. Hence, it is not until the tumour has been cut down upon that any determination, as to the extent of the operative proceeding, can be arrived at. The parosteal form may be carefully removed from the bone, whilst the periosteal and central require excision of the scapula.

The *diagnosis* of these growths is always fairly easy. Generally, they have gained such hold, when the patient comes under observation, that the clavicle, and possibly the head or neck of the humerus, and the soft tissues of the head, neck, and axilla, are already involved. The growth

is usually well-defined; its surface possibly lobulated, and somewhat elastic on palpation; it is very rapid in development, and the subcutaneous veins are enlarged and prominent. There may or may not be pain; this must depend upon the invasion of the growth.

The sarcomata are most frequent in young subjects at about the age of puberty, and are possibly associated with some injury to the shoulder, although they often appear spontaneously. They are very malignant, and their growth and recurrence after removal are rapid, the latter occurring locally or in some viscus.

ENCHONDROMA is sometimes met with, springing either from the venter, dorsum, or, more frequently, one of the processes. It is uniformly firm in consistence, often nodular, painless, and of slow growth, although occasionally this is not the case.

GUMMATA are sometimes met with about the scapula. When occurring in the muscular structures, they may assume the appearance of real growth, and, as they are almost invariably of rapid development, may be mistaken for sarcoma. The history of the case will aid the diagnosis, and the exhibition of specific treatment in such cases of doubt is of the greatest value, the gumma speedily disappearing under its use. When gummata are situated superficially, they may simulate abscess.

ABSCESS may be either quite superficial or develop in the supra- or infra-spinous fossæ, beneath the fascia, as the result of injury, or spontaneously, unassociated with any disease of the scapulo-humeral articulation. It often commences as acute inflammation of some bursa, and the matter remains for a time pent up by the dense fasciæ, and eventually makes its way either towards the surface or into the axilla.

Subscapular abscess not infrequently occurs in the loose connective-tissue between the subscapularis and serratus magnus, and is most frequently a result of some lymphatic absorption, although it may occur spontaneously, and after some local injury. The ordinary symptoms of fluctuation—at first, at any rate—may be absent, as the collection of pus is so deep; but the high temperature, the throbbing pain, and the separation of the scapula from the thorax, together with the increasing inability to move the arm, and the gradual filling up of the axillary hollow, all point to the probability of abscess. An exploratory puncture should complete the diagnosis.

BURSAL TUMOURS.—The large bursa between the inferior angle and the thorax is

sometimes so enlarged as to present the appearance of a rapidly growing malignant tumour. It is usually noticed as the result of some over-strain or exertion, such as may be produced by rowing, cricket, or tennis. It appears as a tense, fluctuating tumour, pushing up the scapula and often encroaching on the axilla. If the growth be of long standing, its walls become much thickened, and it may be readily mistaken for a solid tumour. Occasionally, these enlarged bursæ contain melon-seed bodies, and on pressure or manipulation crepitus is detected; here, again, puncture with a trocar or aspirator reveals the nature of the swelling. Persons following particular trades develop bursæ over the scapula; thus bricklayers' labourers and porters frequently have an enlargement of the bursa immediately over the anterior edge of the trapezius. Such tumours occasionally suppurate.

PERIOSTITIS and OSTITIS, acute and chronic, are occasionally met with, and may be limited to certain portions of the bone or involve it entirely. They are sometimes due to struma or syphilis, occur spontaneously or as the result of exposure or injury, but more frequently are secondary to disease in the scapulo-humeral articulation or head of the humerus. The symptoms are much the same as in any other region; although, from the dense muscular and fascial coverings, the diagnosis is, at any rate in the early stages, not always easy. There is deep-seated pain referred to the bone itself, a rigor, and rise in temperature; swelling and cedema of the soft parts do not usually appear as rapidly as in the case of the more exposed and less embedded bones, but if the inflammatory attack be severe, suppuration is usually very rapid and diffuse. The resulting abscess points either in the axilla or in the supra- or infra-spinous fossæ.

NECROSIS of the scapula, either partial or entire, is generally the result of the above conditions, and when sinuses have formed, a probe will detect bare bone. The periosteum is very often detached entire, so that operative interference is comparatively easy when the diseased tissue is exposed.

DISPLACEMENT OF THE SCAPULA.—The peculiar condition, to which this term has been applied, is a displacement of the lower angle and spinal border of the scapula, whereby the bone seems to be lifted away from the thorax. It was formerly considered to be due to the scapula shifting from under the latissimus dorsi, but it is

now known to be the result of paralysis of the serratus magnus muscle, which may be partial or complete. The remarkable tilting up of the bone is due to the preponderance of power in the trapezius, levator anguli scapulæ, rhomboidei, and pectoralis minor.

The *diagnosis* is easy. If the arms are held forward, at right angles to the trunk, the elevation of the spinal border of the affected side is most marked, and the patient can project the sound arm about two inches further from the thorax than the affected one. The movements of rotation of the bone are either feeble or wanting on the affected side; in fact, the serratus magnus is incapable of performing its special functions.

Electricity seems the chief element in *treatment*; and Erichsen states that he has seen much benefit derived from the endermic application of strychnine on a blistered surface, followed by support by means of some properly devised apparatus.

EDWARD BELLAMY.

SCAPULA, Dislocations of the.—

Dislocations at the acromio-clavicular joint are sometimes described as dislocations of the acromial end of the clavicle, but they are more correctly classed as dislocations of the acromion process of the scapula. This may be displaced *downwards* or *upwards*.

DISLOCATION DOWNWARDS, though not a frequent injury, is far more common than dislocation upwards, and this is to be explained partly by the direction of the force, and partly by the direction of the articular facet, which on the acromion looks upwards and inwards. The injury is caused by a fall on the point of the shoulder, and the resulting deformity is easily recognised. The acromion process falls below its proper level, and the outer extremity of the clavicle rides upon it. The end of the clavicle forms a very distinct projection immediately beneath the skin, the nature of which it is scarcely possible to mistake. By drawing the shoulder well back and at the same time raising it slightly, the dislocation is easily reduced, but the deformity recurs immediately the support is removed; and thus, both in its tendency to relaxation, and in the extra mobility it occasions, this dislocation forms an exception to the rule. The difficulty of retaining the bone in position is so great that some have given it up as hopeless, and South recommended that no trouble should be taken, the clavicle being allowed to unite by fibrous tissue to the acromion, in its abnormal position. With great care and a tractable patient,

however, it is possible to obtain a cure without deformity. In other cases, the writer would suggest that it may be justifiable to excise the joint and wire the bones together; but it should be remembered that, if the bones are united in the dislocated position, the arm remains useful and but little weakened.

To reduce the dislocation, one hand should draw the shoulder well back, whilst the other is used to raise the elbow. To retain the bones in position, it is usual to place the arm in bandages similar to those used for fractured clavicle, but, in the writer's opinion, bandaging alone is wholly inefficient. He advises as follows:—A little absorbent cotton-wool, covered with zinc powder, should be placed in the axilla to prevent intertrigo; the arm should be carried forward so that the hand rests on the other clavicle, and the elbow be then forced upwards and outwards. Broad strips of Holland plaster (which does not stretch) should next be used to bind the arm to the side, and, to support the elbow and arm, strips should be carried over the opposite shoulder; a soft pad should be placed on the clavicle, and a broad strip of plaster be carried from the back over the pad and under the elbow. When the surgeon has tested the efficiency of the strapping, he should protect any prominences of bone with cotton-wool, and then cover the whole with plaster of Paris bandages. M. Laugier in eleven cases employed a tourniquet to keep down the clavicle. The arm should be fixed for six weeks.

DISLOCATION UPWARDS is very rare, and is caused by force applied to the upper surface of the clavicle. Besides rupture of the acromio-clavicular ligaments, the conoid and trapezoid give way. The rotundity of the shoulder is lost, and two bony projections appear, the upper and inner formed by the acromion, and the lower and outer by the end of the clavicle. The humerus rotates without difficulty, but the patient cannot raise his hand to his head. Reduction is accomplished by drawing the shoulder back, after which it is necessary to confine the arm to the side for five or six weeks.

Dislocation of the Coracoid Process upon the Clavicle was described in 1843 by Godemer, who related five cases as having come under his notice in five years, since which time M. Pinjon has added a sixth. Malgaigne throws doubt on the extraordinary experience of his compatriot, suggesting that both in the symptoms and in the effect of treatment the cases resemble

each other too closely to be all taken from nature. This dislocation must therefore be left for further experience to establish.

R. CLEMENT LUCAS.

SCAPULA, Excision of the.—This operation is indicated in cases of necrosis or of new growths. It is not without its difficulties, and these of course vary with the size or situation of the tumour; hence, any typical operation can scarcely be described. Such operations may be considered as (1) total resection or extirpation, in which the shoulder-joint is opened, and the glenoid cavity removed; (2) removal of the scapula, leaving the glenoid cavity and shoulder-joint, the neck being divided by a saw; and (3) resection of certain portions of the bone, especially of the spine, angles, or acromion process.

If it be necessary to remove the entire scapula, the most convenient method is as follows:—The subclavian artery being controlled by an assistant, and the arm extended from the side, an incision is to be made along the posterior border of the bone, and a second one along the spine, joining the first and terminating at the tip of the acromion. The triangular flaps so formed are next to be dissected off, thus exposing the mass to be removed. The muscles attached to the posterior border are then to be divided close to the bone, so as to allow of its being grasped by the hand and lifted off the thorax. The knife is then carried along the upper border, dividing all muscular attachments. The acromion process may be either disarticulated from the clavicle or cut through with forceps, or, what is preferable, the acromial end of the collar-bone divided. The muscular attachments along the axillary border should next be divided, and it is at this stage of the operation that the bleeding may be troublesome. The vessels should be clamped or tied as divided. The mass is then fairly free, and, being still further lifted up, the joint is next opened and the disarticulation effected, the remaining muscular attachments being divided, and the bone removed, the vessels ligatured or torsioned, and the flaps adjusted as in any ordinary amputation.

Subperiosteal resection is performed in cases of necrosis, and the bone being exposed by the above incisions, by means of rugines the periosteum may be stripped off; the attachments of the several muscles being preserved. There are several instances recorded of the entire scapula and its processes being removed subperiosteally with complete reproduction.

The actual operative proceeding is as follows:—An incision is made from the tip of the acromion to the base of the spinous process; a second incision is next to be made, commencing at the superior angle and following the spinal border of the scapula, terminating at the inferior angle. The incisions are carried through the periosteum. This membrane is first stripped off the acromion, next the spine, taking care to preserve the attachments of the deltoid and trapezius. The posterior border is then to be denuded, with the attachments of the rhomboidei. The periosteum should next be removed from the infraspinous fossa, and the infraspinatus and teres minor separated, followed by the detachment of the supraspinatus from its fossa. The articulation is next attacked on its posterior aspect, and the capsular ligament turned up from its attachment to the neck of the bone. The arm should now be extended, and the inferior angle of the scapula lifted up, and the bone thus tilted from within outwards. This exposes the subscapular fossa, and, on lifting the bone still further from the thorax, the anterior aspect of the capsule should be scraped off and opened. The bone should next be seized by strong forceps and twisted outwards. Such are the directions laid down by Ollier, as an exercise, presumably, on the cadaver, but in actual practice the separation of the periosteum, if not already complete pathologically, is of very easy performance, and has been practised with the most satisfactory results.

EDWARD BELLAMY.

SCAPULA, Fractures of the.—This bone is so movable, its processes are so strong, and it is for the most part so thickly covered with muscles, that it is very seldom broken. Its fractures are almost invariably due to direct and considerable violence; very rarely to muscular action. They are divided into those of (a) *the body*, (b) *the neck*, (c) *the acromion*, (d) *the coracoid process*.

FRACTURE OF THE BODY is caused by the passage of a wheel, by falls on the back upon a projecting stone or the like, or by a heavy blow. Though often transverse, its rays may extend upwards through the spine, or obliquely through its anterior or posterior border. It is often starred or comminuted.

Symptoms.—These are mobility of the fragments when the bone is grasped at different parts, or when the inferior angle is grasped, or the hand placed flat on the bone, while the arm is moved by an assistant;

accompanying crepitus, often a mere click, caught only on one particular movement. In fracture of the spine or of the borders, particularly in thin persons, displacement may be detected. In fractures below the spine, the lower fragment is generally found in front of the upper, and carried upwards, so that the bone is shortened from above downwards. But this is by no means constant.

Treatment.—Such readjustment as may be possible having been effected by manipulation, the scapula should be covered with a carefully moulded and well-padded gutta-percha shield for protection, and the arm fixed by bandaging in the position in which the fragments are found to be most easily maintained in place. Some deformity will probably remain, but this will usually not impair the functions of the arm.

FRACTURE OF THE NECK.—There appears to be no example in any museum of fracture of the anatomical neck of the scapula—that is, of a fracture detaching merely the glenoid cavity, and it may be very strongly doubted whether this injury ever occurs. There are, however, dissected specimens showing fracture through the surgical neck; that is, through the narrow part by which the glenoid cavity and coracoid process together are attached to the remainder of the bone.

Symptoms.—In this rare accident, always the result of a crush or other form of direct violence, the shoulder is somewhat flattened, as in dislocation of the humerus; the normal outline may be restored, and perhaps crepitus felt, when the elbow is raised; but deformity returns when the arm is allowed to hang down. The humerus is abnormally movable in all directions, and its head can be felt in the armpit. The patient is unable to raise the arm, and passive movement causes severe pain.

Treatment consists in placing a pad in the axilla; raising the arm, and supporting it by means of a firm sling acting on the elbow and forearm, and bandaging the arm to the side and the forearm across the chest. Movement, which is likely to be much impaired, may be improved by manipulating the limb, under an anæsthetic, at the end of six weeks, and subsequently employing passive movements, combined with hot douching and shampooing. Fracture of the margin of the glenoid cavity, or a stellate fracture of this cavity, is sometimes present as a complication of dislocation of the humerus. See SHOULDER-JOINT, Dislocations of the.

FRACTURE OF THE ACROMION is caused by falls on the shoulder or by a blow from above. The size of the fragment varies, and may include merely the tip or the whole process to the root of the spine. The injury is rare. Many supposed fractures with ligamentous union are instances of separation of the acromion, apparently at the line of junction of the epiphysis with the rest of the bone, in the course of rheumatic arthritis. In St. Bartholomew's Hospital Museum is a specimen of this kind, in which the acromion is divided into two pieces, one of which is still connected with the spine by a very narrow bridge of bone, the other, at the tip, being joined to the first piece by fibrous tissue.

Symptoms are dropping and flattening of the shoulder, pain, loss of power to raise the arm, displacement, and the rough edge of the fracture felt on passing the finger along the bone. The deformity is removed by elevating the arm—when probably crepitus can be felt—but returns when the arm is allowed to hang down.

Treatment.—A pad having been placed in the axilla, the arm must be supported in a sling, and bandaged across the chest, as in fractured clavicle. Union is generally fibrous, but there is slight if any impairment of the functions of the limb. Bony union might probably be secured by confining the patient to bed, and raising the arm, so that dragging on the fragment might be prevented.

FRACTURE OF THE CORACOID PROCESS,
see CORACOID PROCESS, Fracture of the.
HOWARD MARSH.

SCARIFICATION.—A method of local blood-letting, extremely limited in scope and generally of doubtful utility.

The operation consists merely in making a number of small, very superficial cuts, which may be crossed by others, and allowing the blood to ooze from them.

It is sometimes recommended in conjunctival chemosis, in the early stages of acute tonsillitis, in cedema and engorgement about the glottis, and in certain conditions of the os uteri. On the skin it is useless.
WILLIAM H. BENNETT.

SCHIZOMYCETES.—*Synon.* Bacteria, bacteridæ, vibrios, schistomycetes, micro-organisms, microbes, microzymes, cocco-bacteria.

Schizomycetes is the classical name, now in general use, to express the whole class of micro-organisms formerly known indefinitely as bacteria, that term being now

restricted to one genus. It signifies the fact that organisms of this class reproduce themselves by fission of the parent organism, and this is the case with all species, though not the only method in several.

This class of organisms was arranged by Cohn in the following order of genera, which has been found to be by far the most practical:—

MORPHOLOGY.—*A. Coccus* forms.—Spherical or oval organisms; subdivided by Billroth into micrococcus and megacoccus. *See* MICROCOCCUS.

B. Bacterium (q.v.).—A short, oval, or cylindrical rod-shaped organism, with rounded ends, or also an ellipsoidal shape constricted in the middle like a biscuit (clithridium). In any case the length of the organism does not exceed twice its breadth.

Varieties of bacterium are frequently provided with a flagellum.

C. Bacillus (q.v.).—Rod-shaped organisms, in which the length of the adult element is much greater than its breadth. This is perhaps the most important genus.

D. Vibrio (q.v.) is practically a curved bacillus, the curves (1-2 in number) being always in the same plane.

E. Spirillum (q.v.) is a spiral-shaped thread, which when greatly overgrown has received the name spirochæta, these latter forms being also more flexible.

Habitat.—These organisms are found in varying quantities in the air, in water, and in the soil. The quantity in the air of temperate climates varies according to the height from the earth, to the action of the wind in raising dust, and temperature—i.e. according to the season of the year. Some species attack and inhabit the interstices of living animal tissues, while very many exist as parasites on the cutaneous and mucous surfaces of the body.

Structure.—All the schizomycetes consist of a protoplasmic body, containing small fat and sulphur particles, and staining readily with anilin dyes. This protoplasmic body or core is surrounded by a sheath, which possesses many characters of cellulose, and offers powerful resistance to many chemical reagents. The protoplasm is an albuminous substance, the basis of which is an albuminoid compound termed mycoprotein, which contains no combined sulphur. In several species the protoplasm is pigmented, the prevailing colours being yellow, orange, red, and blue.

LIFE CHANGES.—*Respiratory.*—All forms require oxygen, and give out carbonic acid. Most need free oxygen, and there-

fore are termed aerobic; others can probably take the oxygen from combination, and hence have been termed anaerobic; but this division is not satisfactory. In some (bacilli), the growth when exposed to free oxygen tends to spore-formation.

Thermic.—All forms grow best at about 36° C. (96·8° F.). All adult forms are killed at 50° C. (122° F.) moist heat, and by severe cold. Spores, however, survive much greater extremes, viz. 120° C. (248° F.) dry heat.

Very few forms can grow in pabulum which is kept in rapid motion (e.g. blood, &c.). Light appears slightly to retard growth, and electricity also, but this latter probably by electrolysis of the pabulum.

Chemical.—These organisms split up both simple and complex substances to gain the necessary elements for their nutrition. They require hydrogen, nitrogen, oxygen, and carbon, while at the same time it is essential that there should be a trace of phosphate in the nutrient fluid. As results of the catalytic action of their life, fats, albuminoids, and carbohydrates are broken up in a way that can be imitated by the action of superheated steam and potash, so that it is probably a process of hydration. Thus, fats become rancid from the development of butyric acid, &c.; the carbohydrates and glycerine are decomposed into alcohol, butyric and carbonic acids; albumins are broken up into glycocoll, leucin, tyrosin, and aromatic compounds, while the former again are resolved into ammonias and lower acids.

On living tissues the schizomycetes appear to exert a progressive necrotic action, partly due to their breaking up the tissue for nutrition, and partly, perhaps, to the effect upon the healthy tissue of the products of such decomposition. See SEPSIS; SEPTIC DISEASES, Classification and Etiology of.

REPRODUCTION.—This is effected either by fission or spores.

(a) *Fission.*—According to the elevation or depression of the surrounding temperature, an adult organism will quickly or slowly divide into two, usually first elongating, but in rapid subdivision the daughter elements are very short, so that the primary elongation is slight. In the rod forms, the subdivision is always at right angles to the direction of the long axis. In the coccus forms, the subdivision takes place in every direction, and thus sarcinoid groups of four or more result. *Vibrio* forms appear to possess the power of vacuolating and then dividing longitudinally

(Klein). When organisms grow rapidly by fission, they form masses termed zoogloea, the individual organisms composing which are held together by an albuminous substance, which sometimes forms a gelatinous envelope.

(b) *Spores.*—In the presence of free oxygen, many bacilli tend to grow into long threads (leptothrix), in the interior of which there develop brightly refracting spots which by atrophy of the rest of their filamentous sheath become free, as oval protoplasmic masses surrounded by a very resisting sheath. A similar process of spore-formation may be seen in adult rods. These bodies are spores, and, under suitable conditions, will elongate and develop into single rods. They possess fully three times the power of resisting destruction by heat, chemical reagents, &c., that the adult rods do, and, consequently, play an extremely important part in the etiology of diseases such as malignant pustule, &c.

Practical Importance.—The practical importance, to the surgeon, of the existence and life-processes of these parasitic organisms cannot perhaps be exaggerated; but since this point involves the question of fermentation and etiology of infective diseases, it is fully described in the article on SEPTIC DISEASES, and need not be repeated here. The treatment of the different conditions, with which micro-organisms are actively concerned, will also be found under the various septic diseases.

VICTOR HORSLEY.

SCIATIC HERNIA.—This form of rupture is very rare. The protrusion escapes through the great sacro-sciatic foramen. The fundus of the sac is found beneath the gluteus maximus muscle; the neck may be either above or below the pyriformis, and will be in front of the gluteal artery, and below the obturator. Sir Astley Cooper has reported a case where a piece of ileum was strangulated in this position. The hernia was not discovered until after death. The hernial orifice could be readily examined by introducing the hand into the rectum.

FREDERICK TREVES.

SCIRRHUS. See CARCINOMA; BREAST, Diseases of the.

SCLEREMA NEONATORUM.—*Definition.*—An induration of the skin, with lowered temperature, occurring congenitally or soon after birth. Until Parrot distinguished between the two affections, sclerema and oedema neonatorum were mixed up together.

Etiology.—Sclerema may be primary or secondary. The primary cases are either congenital, or occur in a very few days after birth, without apparent cause. The secondary cases are the sequel of causes which depress vitality, such as diarrhoea or pulmonary affections, like pneumonia, with collapse or atelectasis; it is apt to occur with malnutrition from bad feeding and defective hygiene. Œdema happens, almost invariably, in infants which are premature or of otherwise feeble vitality, and there, too, atelectasis is frequent; bad feeding of mother and child, or exposure to cold immediately after birth, are also causes.

Pathology.—Langer considers the first condition a 'fat sclerema'—i.e. due to solidification of the fat; infantile fat having a much higher melting point than adult fat. On the other hand, Parrot regards it as a consequence of desiccation of the tissues from the drain of diarrhoea, &c.

Œdema is presumably due to the feeble circulation and defective aëration of the blood at a period when vital resistance is always small.

Symptoms.—When not congenital, the induration generally begins in the lower limbs—rarely in the face—within ten days of birth, spreads to the trunk, and is usually complete over the whole body-surface by the fourth day from its commencement; but it may remain incomplete. At first, the skin is of a yellowish-white or waxy appearance, but it soon gives way to a slightly livid tint, and the skin becoming adherent to the subjacent tissues as well as rigid, it cannot be pinched up, and there is no pitting on pressure. The skin is tense, smooth, cold, and hard. The limbs and jaw are fixed, the eyes closed, and the child lies motionless with the exception of slight movements of the thorax and face, the latter being less rigid than other parts; but the stiffness of the lids and cheeks prevents sucking, the pulse, respiration, and temperature sink far below the normal, and life is completely extinguished within a week.

Œdema begins in the third day of life, with drowsiness, swelling of the extremities, especially of the legs, which pit on firm and prolonged pressure, and are cold and livid. The œdema spreads up to the thighs, then to the hands, the genitals, and back; the soles and pubes are especially affected, and are red and hard, sometimes doughy. The drowsiness increases, the pulse gets feeble, the respiration slow and shallow, and complications, such as pulmonary af-

fections, with collapse, diarrhoea, or convulsions, hasten the fatal issue; jaundice sometimes supervenes just before death. Recovery takes place in some cases, if they come early under treatment.

Diagnosis.—Though so much alike in etiology, and in the depression of the vital processes, these two affections may be distinguished by the following points:—

In sclerema, the disease is general; the skin, tense, hard, and waxy in colour, does not pit, and cannot be pinched up.

In œdema, the disease is less widely spread, the skin is livid from the first, not so hard as sclerema, pits on firm pressure, and can be pinched up, while the swelling is always greatest at the lowest parts. In sclerema the joints and jaw are stiff; not so in œdema, or only in a slight degree.

The onset so soon after birth is alone sufficient to distinguish both forms from scleroderma, in which no case under two years has been recorded.

Prognosis.—Death invariably ensues in a few days, when the induration is universal; but in the rare, incomplete cases recovery may be hoped for. In œdema the prospect is not quite so hopeless, though always serious, and the cases last longer.

Treatment.—Efforts must be made to keep up the temperature; the child should therefore be wrapped in cotton-wool, and surrounded by hot-water bottles; friction of the limbs with oil is also a useful measure. As the child cannot suck, food must be introduced into the stomach by a small stomach-pump tube passed through the nose, or by Battam's plan of attaching an india-rubber tube to the nozzle of a glass syringe, passing it into the pharynx, and then injecting the food; peptonised milk and white-wine whey are suitable aliments, for digestion, like the other functions, is at its lowest ebb.

H. RADCLIFFE CROCKER.

SCLERODERMA, or hide-bound disease.

Definition.—A subacute or chronic disease, characterised by extreme induration and rigidity of the skin.

This disease is a rare one, and has nothing in common with sclerema neonatorum, except the hardness of the skin, which is due to a different cause. There are three classes of cases: one in which the skin-affection is diffuse and symmetrical, another in which it is circumscribed, and a third or mixed class which partakes of the characters of both the other forms. The first two require, to some extent, separate con-

sideration, as the symptoms and etiology are in many respects very different.

Etiology.—Females are much more prone to this disease than males, in the proportion of three to one in the case of diffuse, and a still larger proportion in circumscribed scleroderma. It may occur at all ages from two years and upwards, but is most frequent in young and middle-aged adults. In diffuse scleroderma, previous attacks of acute rheumatism and erysipelas are the most frequent remote antecedents, and exposure to wet or cold is the most frequent exciting cause. Cases that follow from definite conditions are generally acute in their onset; while, frequently, no cause can be traced for those which are slow and insidious in their development; and, in many instances, the patient has been in good health until attacked with scleroderma.

The cause of the circumscribed form is quite obscure. In many there is a history of worry, anxiety, or other depressing mental influence antecedent to the appearance of the patches; in a few, chiefly band cases, local irritation or injury appeared to be the exciting cause; whilst the rest seemed to be spontaneous in their development.

DIFFUSE SYMMETRICAL SCLERODERMA.
Symptoms.—These cases are seen in two phases: one where the skin is swollen, the other where it is shrunken. The first is usually, but incorrectly, ascribed to hypertrophy, but is really due to infiltration; and the shrunken state is one of atrophy. The swollen stage is the early condition, and may be quite hard from the first, or stiffly œdematous; and the shrunken stage is a sequel to the œdematous variety.

The common history is that the disease came on after exposure to cold or wet, arthritic pains and perhaps the symptoms of subacute rheumatism sometimes attending the onset; or there may be no other symptoms except those of the skin. A feeling of stiffness of the skin is first experienced, hindering movement, and attended by a sense of tension; and the affected part becomes quite hard, rigid, and cannot be pinched up. This symptom may come on quite suddenly, or so slowly and insidiously that the patient is scarcely aware of its commencement.

The upper half of the body is most frequently attacked, the stiffness being first felt in the back of the neck, the chest, shoulders, or arms. Once started, the process may spread slowly or rapidly over a large area, or even over the whole body-surface;

but the lower half is never attacked without the upper being involved, though the converse often happens. Whatever be the extent—and the disease is often very erratic in its distribution—symmetry is preserved. The palms and soles are rarely involved, but any of the mucous membranes may be affected. The edge of the affected area merges imperceptibly into the surrounding skin, while the affected part is extremely tense, and, when the parts beneath are affected, the muscles feel as if rigor mortis had set in. No pitting can be produced on pressure, and no fold can be pinched up; the surface is pale and marbled by dilated small vessels, and sometimes pigmented to a varying extent. If the face is involved, the features are as fixed as those of a statue, and when the trunk is attacked, respiration is interfered with; while in the limbs the joints are immovable and more or less flexed from contraction of the distended skin.

There is no alteration in the sensibility, but itching is sometimes troublesome, and sweating is more or less in abeyance. Subcutaneous tubercles, like rheumatic nodules, have been observed in a few instances.

In the œdematous cases, instead of induration a stiff œdema is present at the commencement, and the real nature of the disease may be unsuspected at first. After lasting some weeks or months, the œdema gets absorbed, the skin shrinks, acquires a dead or ivory-white hue, and the atrophic stage is developed. This atrophic condition is usually less widely spread than the œdema which preceded it, and is often confined to the limbs and face, but the symmetry is retained. The skin is now as tense as before, but from contraction, not distension; in the face the skin is strained over the bones, and may be directly adherent to the periosteum from compression-atrophy of the fat and muscles; the lips are drawn up, the gums retracted, and the teeth in extreme cases fall out. The countenance is bloodless, except where mottled by telangiectases, and the fixed features and straining of the skin over the bones give a ghastly corpse-like aspect; the limbs of an adult may be reduced to the size of a child's, the joints ankylosed, and the hand claw-like. In consequence of the tension of the skin over the joints, ulcerations, sometimes attended with necrosis, easily ensue from slight injuries.

The course taken by these two forms varies somewhat; the tensely infiltrated cases tend to clear up sooner or later, the infiltration is gradually absorbed, the skin

becomes less rigid, and after some months, but in some cases not for years, the skin gradually regains its normal softness and elasticity. Some think that these cases may also merge into the atrophic form, but this is not the opinion of the writer. Progress may be interrupted if the patient get a chill, and even extension may then ensue, and, according to patients' statements, the skin is tighter on some days than others. In the contracted cases recovery is less frequent, the disease often remains stationary for years, or it may extend at long intervals. The general nutrition suffers, and the patient gradually sinks or dies from intercurrent disease. It is a long time, however, before the general health suffers, and many seem to be little the worse except from their helplessness.

No special complications, except rheumatism and valvular heart-affections, are found associated with this disease, but other eruptions may be present, and filaria sanguinis hominis has been twice found.

CIRCUMSCRIBED SCLERODERMA, or MORPHEA, is, by some authors, still regarded as an entirely independent disease; but the other view gains ground, and will doubtless eventually prevail.

Symptoms.—It occurs in patches and bands, the former being the most common. The patches, which may be single or multiple, are usually from half to two inches or more in diameter, situated generally on one side of the body, often in the course of a nerve, like herpes zoster, but sometimes in the middle line, sometimes bilaterally, and occasionally symmetrically. They develop gradually, rarely rapidly, without any symptoms. The domain of the fifth nerve, the breasts, and still more frequently the limbs, are favourite positions, but they may come anywhere.

The majority of the patches are of an ivory-white colour, smooth and dry, surrounded by a pink or violet zone of minute dilated vessels; but this zone may be absent, and the patch more or less pigmented in various hues. The edge may be diffused or defined, its shape is as irregular as its size; it may be raised above (*M. tuberosa*), depressed below, or level with the surrounding skin. No difficulty is usually experienced in pinching up the diseased skin, and as it is rarely adherent to the subjacent tissues, and is quite superficial, it feels like parchment or leather, according to its thickness, which varies often in the same patch. As a rule, when once it is developed there is no increase in size, but sometimes small atrophic spots appear

close to the major patch, enlarge, and coalesce with it.

Defects of sensibility are rare, but there is itching in some cases. In the band cases, the lesion is usually single, and, unlike the patches, is often adherent to the subjacent tissues, so that it is sunk into a sulcus below the healthy skin; but if non-adherent it may be raised up into a ridge.

Pathology.—The pathology of this affection is obscure, but the process does not appear to be inflammatory, and the theory most in accordance with the clinical facts is that of an obstruction of the arterial blood-supply to the skin, on the one hand, and the venous and lymph flow on the other; and the varying symptoms of different cases depend upon the relative degree of obstruction in one or other of these vascular systems. But what the primary defect is that brings this about is not known, and it must be inferred that it is of central nervous origin, and in fact that the disease is primarily a central tropho- or vasomotor-neurosis. Diffuse scleroderma has been anatomically examined by many, and the results, omitting minor differences, are as follows:—The changes are, in the main, in the deeper parts of the corium and subjacent tissues, and consist of narrowing of the lumen of the blood-vessels and accumulation of cells round them.

Later on there is destruction of the sweat and sebaceous glands and hair-follicles, and absorption of the fat and cellular tissue by the pressure of these cells, and a great development of connective and elastic tissue bundles, doubtless from fibrillation of the cells; and the skin may become directly adherent to the fascia or periosteum.

The anatomy of circumscribed scleroderma has been examined by the writer. The changes were of very similar character to those of the diffuse form, but were more superficial, affecting the upper part only of the corium, in the early stage; and thrombi were present in many of the vessels, explaining the pallor and thinning present at first. At a later stage there was increase of the connective tissue, and the changes had spread into the deep part of the corium and into the fat layer. In the opinion of the writer, the obstruction to the arterial blood-supply is greater than in diffuse scleroderma, and so atrophic changes are more often produced. Probably the nervous defect is not central, affecting perhaps only single nerves in this class of cases.

Diagnosis.—The wooden induration and immobility of the skin and subcutaneous tissues, occurring symmetrically over a wide

area, with or without the ivory colour super-vening, are conditions almost peculiar to diffuse scleroderma, with the sole exception of sclerema of the newborn, in which there is induration with great coldness of the surface; this, and the age of the patient, would be obvious distinctions. There remains only one disease, even rarer than scleroderma, which may give rise to some doubt—namely, diffuse primary or secondary cancer of the skin—the '*Cancer en cuirasse*' of Velpeau. If secondary, it often begins with nodules; this and the previous history would remove all doubt, but in the primary cases there may be more difficulty. The slow, continuous spreading, the lancinating pains and tenderness, the neighbouring inflammatory cedema, the ulceration of the lesions and involvement of the glands, with the more rapid course of marasmus and fatal cachexia, are all points in which it differs from scleroderma.

Circumscribed scleroderma presents even less difficulty. The raised patches might perhaps be mistaken for the keloid of Alibert, but the difference in colour, the ivory-white tint of morphœa being absent, and the presence of vessels upon the tubercle, and the claw-like processes which extend from it, would distinguish this affection. The flat patches are quite distinctive, and no confusion could arise with ordinary care.

Treatment.—In the diffuse form, the indications are to guard the patient against cold, since aggravation and extension are very likely to follow a chill, to which the patients are abnormally prone; secondly, to improve the general nutrition; and thirdly, to restore the circulation in the ischæmic area. For the first, the patient should be clothed in flannel, never allowed to go out in cold winds, and guarded carefully against draughts.

For the second, ferruginous and other tonics suitable to the individual should be given, and cod-liver oil is often very beneficial. The digestive organs should be carefully attended to, since they partake often in the general enfeeblement, and flatulence aggravates the distressing tension when the trunk is affected.

For the third, shampooing should be systematically and diligently employed to the affected areas. Turkish baths are useful before the rubbing, but vapour baths are too depressing.

Where Turkish baths are not available, inunctions with neat's-foot or olive oil, or simple unguents are useful; galvanism is strongly recommended by some, and may

be of service, probably, by improving the circulation.

Iodide of potassium, arsenic, and mercury have been repeatedly tried and found useless, and mercurial inunctions have been decidedly injurious in many cases.

The treatment of morphœa is very unsatisfactory; nothing has any direct effect for good, and anything producing local irritation aggravates the mischief. General invigorating measures are useful, and nerve-tonics, such as the mineral acids and nuxvomica, are often indicated. Galvanism has been recommended, but must be used so as not to irritate the patch; but if employed in the neighbourhood may be beneficial. Inunction may also be tried with simple ointments, always remembering that, if not worried by injudicious treatment, the patches tend to get well of themselves eventually. Mercury, internally or externally, should be avoided. The mixed cases should be treated in the same way as diffuse symmetrical cases.

H. RADCLIFFE CROCKER.

SCLEROSIS. See INDURATION.

SCLEROTIC, Diseases of the.—*Anatomy.*—The sclerotic is the white, tough fibrous membrane which constitutes five-sixths of the outer coat of the eyeball. In front, it is continuous with the transparent cornea; behind, with the sheaths of the optic nerve and with the connective tissue investing the fasciculi of the nerve (*lamina cribrosa*). That portion of it which may be seen within the opened eyelids, through the semi-transparent conjunctiva, is called 'the white of the eye.' Externally, it is smooth, except where the tendons of the muscles are inserted, and is enclosed by a thin fibrous covering—the episclera—lined with endothelial cells. This covering—the so-called 'capsule of Tenon'—which also furnishes the sheaths to the straight and the oblique muscles, is very loosely attached to the sclerotic, except in front, where, at about one-eighth of an inch from the periphery of the cornea, it becomes intimately blended with both the conjunctiva and the sclerotic, and cannot be separated from either without laceration. The sclerotic is lined by endothelial cells containing more or less pigment, and is loosely connected with the underlying choroid by many delicate connective-tissue fibres, nerves, and blood-vessels. It is chiefly composed of bundles of fine fibrillæ, among which a few elastic fibres are scattered. The bundles of fibrillæ are irregularly arranged into

layers, which interlace at various angles. Most of the bundles have either a circular or an antero-posterior direction, and a smaller number are disposed obliquely. Around the entrance of the optic nerve, as well as near the cornea, the circular bundles predominate. Among and between the layers is a system of lymphatic channels with spaces containing fixed cells, closely resembling those of the cornea. Most of the cells are unpigmented, but a few are pigmented. The latter are found chiefly around the entrance of the optic nerve, and in the deeper layers of the sclerotic near the cornea. In negroes and dark races generally, the proportion of pigmented cells is always greater. Migratory cells also circulate in the lymphatic channels.

The sclerotic has comparatively few blood-vessels and nerves. It receives a few small branches from all the ciliary arteries and veins. These vessels form a wide-meshed plexus, chiefly on the surface, in which, as a rule, two veins accompany each artery (Leber). On the anterior surface, around the margin of the cornea, the distribution of the blood-vessels is peculiar. At about one-twelfth to one-eighth of an inch from the cornea, the anterior ciliary arteries, which are the terminations of those supplying the straight muscles, divide into—(a) perforating branches, which pass through the sclerotic to go to the ciliary body, where they join the posterior ciliary arteries, and (b) superficial branches, which lie in the episcleral tissue and anastomose by arched communications in the neighbourhood of the corneal margin. The latter are called episcleral arteries. From these arcades two sets of branches arise—one consisting of small straight vessels which run up to and within the limbus of the cornea, and form with the subjacent episcleral veins the marginal vascular plexus of the cornea; the other consisting of vessels which bend backwards, to end in the conjunctiva and anastomose with the posterior conjunctival vessels. The circumcorneal vascular plexus or ring is therefore made up of episcleral and the anterior conjunctival vessels, which freely communicate with each other, and are directly connected with the vessels supplying the anterior portion of the conjunctiva, the sclerotic, the cornea, the ciliary, and the iris. Hence, in inflammation affecting these parts, the marginal plexus, which in health is almost invisible, becomes more or less conspicuous, forming what is generally called 'the zone of ciliary injection.'

Pathology.—Containing few blood-vessels, nerves, cells, and lymphatics, and

subservient only the functions of an exoskeleton, the sclerotic is a comparatively indifferent structure; its composition is stable, its nutritive processes are sluggish and not easily diverted. Consequently, it is but little susceptible of disturbing influences, and is subject to few pathological changes. Indeed, when these changes do occur, they are generally associated with and dependent upon morbid states of one or more of the adjacent textures—namely, the ciliary body, the choroid, or the iris, or, much more rarely, the cornea.

It is at first sight remarkable that, notwithstanding the unbroken structural continuity, the sclerotic proper is seldom much affected in inflammation of the cornea; though it readily participates in inflammation of the iris and ciliary body, to which it is contiguous only. The explanation seems to be, that the nutrition of the cornea is, in the main, distinct from that of the sclerotic, and that both these structures are alike primarily dependent upon the integrity of the ciliary body for their organic maintenance.

The commonest inflammatory manifestation, referable to the sclerotic, is now known to involve rather the episcleral tissue than the substance of the sclerotic. The morbid state is still, however, often spoken of indiscriminately as scleritis or scleritis and episcleritis. The truth is that though episcleritis may occur alone, it is not infrequently associated with inflammation of the sclerotic. The concurrence is to be accounted for partly by the nature of the inflammation and its exciting cause, but chiefly by the anatomical peculiarities of its situation. From what has been already stated respecting the relations of the episcleral capsule and the sclerotic, it will easily be understood that the further the focus of disease from the cornea, the less likelihood of a concurrence of scleritis and episcleritis, and *vice versa*. Near the cornea, the union between the two is so close and intimate as to come near to identity of structure, while at a distance the connection is both slight and readily separable.

Nosology.—The principal morbid states of the sclerotic and episclera are:—Hyperæmia, episcleritis, scleritis, staphyloma, and tumours; they are also subject to some slight congenital abnormalities.

HYPERÆMIA.—Hyperæmia of the scleral and episcleral vessels is usually indicative of a morbid state of the cornea, iris, ciliary body, or choroid; or it may signify obstruction to the intraocular circulation, due either

to increased intraocular pressure, or to some other cause. It occurs in two forms—(a) as a pink or, more commonly, a purplish zone, patch, or crescent, at the margin of the cornea; and (b) as large varicose vessels running over the surface of the sclerotic, from about the margin of the cornea towards one or other of the straight muscles.

(a) The former is the more frequent form. Typically, it consists of a purplish zone, varying in breadth from one-eighth to one-fifth of an inch, immediately surrounding the cornea. On examining this zone more closely, it will be found to be made up of the minute radiating blood-vessels described above by the name of *episcleral vessels*. In some cases the injection does not entirely surround the cornea. With the redness there is usually some swelling, due partly to the engorgement of the blood-vessels, and partly to infiltration of the episcleral tissue. The conjunctiva with its vessels may, by gentle pressure and friction upon the edge of one or other lid, be made to glide over the enlarged vessels, which obviously lie upon the surface of the sclerotic. If the conjunctiva also be inflamed, the scleral and episcleral vessels may be masked to some extent by the congested conjunctival vessels, which are distinguishable by their reticular arrangement, and by being largest and most conspicuous towards the lacunar portion of the conjunctival sac.

(b) The varicose state of the scleral vessels is most frequently met with in chronic inflammation of the sclerotic, iris, ciliary body, or choroid, and is generally present in glaucomatous eyes. It may, however, be due to pressure or other disturbances behind the eyeball, either within the orbit or beyond it.

EPISCLERITIS is an inflammation of the loose fibrous covering of the sclerotic. The inflammation may be strictly limited to the episcleral tissue, or it may involve likewise the conjunctiva on the one hand and the sclerotic on the other, or both these structures may be concurrently implicated.

Objectively, episcleritis consists of a more or less circumscribed dusky-red or purplish swelling on 'the white of the eye,' under the conjunctiva, and near the cornea, or within one-third of an inch of it. The most frequent seats are near the corneal limbus, and opposite the insertion of one of the recti tendons, especially the external. The vessels of the overlying conjunctiva are generally enlarged, but the mucous membrane itself is, in the earlier stages at least, freely movable over the swelling.

When the swelling is close to the edge of the cornea, the adjacent portion of the cornea becomes hazy from infiltration into its layers and from disturbance of the epithelium. Eventually, the affected area of the cornea may ulcerate. The sclerotic itself rarely if ever ulcerates in true episcleritis. In some cases, iritis complicates episcleritis; and, more rarely, there is cyclitis.

The *subjective* symptoms are variable. The pain is not usually severe, and does not amount to more than a sense of discomfort, with, perhaps, a dull aching sensation when the eyeball is moved or the eye is used for near work. On the other hand, there is sometimes great pain of a neuralgic character, not only in the globe, but also around the orbit and down the side of the nose. In these cases, however, it will generally be found that there is, in addition to the episcleritis, inflammation of the cornea, or the iris, or even the ciliary body itself. Nor is the sight affected, unless one or other of these parts be implicated.

The *course* of the disease is very chronic. As swelling leaves one part, it may reappear in another, and in this way the case may be prolonged for months. The average duration is about from two to four months.

Termination.—The inflammation may disappear without leaving any traces behind it, or at most only some thickening of the episcleral tissue. In a few cases, a faint discoloured patch persists on the surface of the sclerotic. But if the cornea have been involved, a nebula or actual leucoma may remain.

Clinical Varieties.—At least four distinct varieties of episcleritis may be met with—namely, (1) a circumscribed, indolent, purplish swelling appears opposite the insertion of one of the recti tendons and under the conjunctiva. There is little or no pain, watering, or distress of light. This form may occur during an attack of acute rheumatism, and it is probably always associated with the rheumatic diathesis.

(2) The episcleral swelling is not so circumscribed, and is situated near to the cornea. The conjunctival vessels are enlarged, and there is a patch, or may be, zone of injection at the margin of the cornea. There is also congestion of the iris, as evidenced by a small amount of discoloration and a semi-contracted state of the pupil. The eye waters, cannot bear exposure to light or to cold and damp air. The pain is often very great, both in the eyeball and in the brow. Such cases were formerly spoken of as examples of catarrho-rheu-

matic ophthalmia (Mackenzie). In some cases actual iritis may occur.

(3) Episcleritis may complicate, or be complicated, by phlyctenular ophthalmia. In chronic or recurrent marginal phlyctenular keratitis, the inflammation may extend to the episcleral tissue, and in some cases, following the course of the vessels, it may spread thence through the sclerotic to the ciliary body and iris.

(4) An episcleral infiltration-patch forms near the corneal margin. In a few days the adjoining portion of the cornea is seen to be hazy and its epithelium roughened, and, in the course of one week or more, the infiltration-patch may gradually desert the episclera altogether, to invade the cornea. The softened cornea may then disintegrate and a deep ulcer result. The ulcer, too, often assumes a serpiginous character, and spreads along the margin of the cornea and over the surface; or, running down to the posterior elastic membrane, leads to bulging of the posterior elastic membrane, with prolapse of the iris and ultimate perforation. This form is chiefly met with in anæmic and debilitated persons, especially women weakened through suckling or exhausting illnesses. There may not be much pain in this form, though there is usually great distress of light. The serpiginous form of episcleritis is probably neuropathic. In most of the cases which have come under the writer's observation, there have been other evidences of faulty innervation.

Causes.—Episcleritis occurs chiefly in young and middle-aged adults, rarely in children or in old persons, and it is more frequent in women than in men. The common exciting causes seem to be rheumatism, gout, syphilis, and scrofula. It is sometimes associated with uterine disease, catamenial disorders, and occurs during pregnancy or after parturition.

Treatment.—The local treatment should be soothing. Irritants of every kind are contraindicated. In recent cases, moist warmth, as steam-spray fomentations, is generally agreeable and useful. Sometimes, however, moist warmth increases the pain. In any case, glycerine of belladonna, or weak mercurial ointment containing extract of belladonna, may be applied with gentle friction to the brow or temple, and a solution of atropine may be applied to the conjunctiva, and repeated if found not to irritate. Pain is generally relieved and the duration of the disease shortened by systematic diaphoresis, whether induced by Turkish or other hot baths, draughts or

subcutaneous injections of pilocarpine, or in any other way. Sulphate of quinine, with small doses of calomel (gr. $\frac{1}{4}$ to gr. $\frac{1}{2}$ three times a day), seems, in many cases, to promote the absorption of the inflammatory matters. De Wecker speaks highly of the combination of copious sweatings with the internal administration of salicylate of soda. In chronic cases, blisters may be applied every ten days to the temples, and astringent compresses every night to the closed eyelids. In chronic cases, with opacity of the cornea, *massage* of the eye repeated many times a day has been recommended by Pagenstecher. If there be inflammation or ulceration of the cornea, with a deep anterior chamber and increased intraocular tension, sclerotomy may be tried and repeated at discretion.

SCLEROTITIS.—Idiopathic scleritis seldom, if ever, occurs; inflammation of the sclerotic being generally secondary to iritis, or cyclitis, or choroiditis. See CHOROID, CILIARY BODY, IRIS, Diseases of the.

STAPHYLOMA OF THE SCLEROTIC is comparatively rare, and is the result either of injury with laceration or of inflammation of some portion of the uveal tract.

The common situations are—the corneo-scleral margin, the ciliary region, the equator, and the posterior pole, just outside the optic nerve.

NEW GROWTHS are very rare, so-called tumours of the sclerotic being really growths which have invaded the sclerotic rather than originated in it. Still, fibrous growths and sarcomata do sometimes occur.

Treatment will depend upon the nature of the growth. Malignant tumours cannot be removed too early, even though the eye be certainly sacrificed by the operation. See ORBIT, Tumours of the.

JOHN TWEEDY.

SCLEROTIC, Injuries of the.—The sclerotic is liable to all and any of the injuries which affect soft parts—namely, blows and concussions, contusions, wounds, ruptures, burns, scalds, the effects of corrosives, and other chemical irritants and caustics.

BLOWS, CONCUSSIONS, or CONTUSIONS may be *simple*—that is, affect only the sclerotic—or *complicated* by injury to the adjacent parts. The principal complications are, contusion or wound of the lids or the cornea; subconjunctival ecchymosis; paralysis of one or more of the recti muscles; detachment or laceration of the choroid, iris, retina, suspensory ligament, or the capsule of the lens; hæmorrhage into the anterior chamber, the vitreous, behind the retina or

the choroid; concussion or even laceration of the optic nerve; paralysis of the sphincter pupillæ; suspension of the accommodation.

The nature and extent of the injury may be temporarily masked by hæmorrhage into the anterior chamber or the vitreous, or by the early occurrence of inflammation, or by the presence of old or recent opacity of the cornea or the crystalline lens. It should be remembered that lacerations of the retina and choroid from blows upon the sclerotic rarely, if ever, take place at the site of the blow, but are almost always at the posterior pole of the globe, and are more or less concentric with the optic nerve. More rarely, the rupture occurs in the anterior part of the choroid, but then there is also rupture in the posterior part and in the same meridian (Arlt).

Treatment must be to a large extent palliative and expectant only. The eye should be protected by a shade or by a light cooling compress. Complications and sequelæ must be treated according to their special indications.

Wounds of the sclerotic are, as a rule, very dangerous, because, first, of the degree of violence necessary to produce them; secondly, they are often attended by lesions of the cornea, iris, choroid, retina, crystalline lens, and vitreous; thirdly, they are frequently followed by grave pathological changes, such as inflammation, suppuration, cataract, detachment of the retina, glaucoma, or sympathetic ophthalmitis; and fourthly, they are often difficult to close, partly in consequence of the elasticity of the sclerotic, and partly from the tendency of the choroid or other of the intra-ocular contents to protrude into the wound and become entangled therein.

Wounds of the sclerotic may be *simple*—that is, involve only the sclerotic—or *complicated*. The *simple* wounds are—incised, contused, lacerated, punctured, ruptured, and gunshot. The *complicated* are those with rupture, or with protrusion, or even extrusion of the iris, ciliary body, choroid, retina, vitreous, suspensory ligament, or the crystalline lens itself; those with intra-ocular hæmorrhage, or with lodgment of a foreign body in the wound or within the globe.

Uncomplicated wounds of the sclerotic are comparatively rare, there being in most cases some prolapse of a portion of the uveal tract. When the wound is the result of great violence, and is inflicted by a large blunt instrument, there is almost always laceration of the choroid, with protrusion or extrusion of the vitreous or of the crystalline lens.

In blows with the fist, the rupture of the sclerotic does not take place at the point of impact, but in the ciliary region on the opposite side of the cornea; the usual situation being just outside the cornea and concentric with it, or opposite the interval between the superior and internal recti. But when the blow comes from above, then the lower part of the sclerotic may be torn. If the rupture take place quite close to the cornea, the conjunctiva is also torn, and the lens is forced out of the eye; but when it is more than, say, about one-twelfth of an inch away, the conjunctiva escapes, and the extruded contents of the globe lie under it as in a cyst.

It may be stated generally, that wounds of the sclerotic are dangerous in proportion to the degree of violence with which they were inflicted, the amount of protrusion and entanglement of the iris, choroid, &c., and their nearness to what is called 'the ciliary region.' Other things being equal, a small wound in the ciliary region is much more dangerous than a much larger wound elsewhere; and if there be entanglement of the iris or ciliary body, the risks are very greatly increased. So common is sympathetic ophthalmitis under such circumstances, that this part of the sclerotic is often spoken of as 'the dangerous region.' See SYMPATHETIC OPHTHALMITIS. Again, wounds of the sclerotic, with lodgment of a foreign body within the globe, are necessarily more serious than those without.

Treatment.—The first duty is to endeavour to ascertain the nature and extent of the injury, the second to calculate on the one hand the prospects of good and safe recovery, and of the risks of sympathetic ophthalmitis on the other.

If the eye be obviously destroyed, excision should be performed without delay. Perplexity only arises when, in spite of much apparent injury, there is a fair amount of sight, or when there is only a small wound but in a dangerous region. On the one hand, extensive laceration of the sclerotic may heal and a useful eye result; on the other, even a small wound in the ciliary region, with entanglement, is always, as already stated, a possible source of danger from sympathetic ophthalmitis.

If it be determined to try to save an eye, the lips of the wound should as far as practicable be cleared of all entanglements; all prolapsed tissues being returned or excised. If the wound be large, a stitch may be necessary to prevent escape of vitreous. This should be inserted by using a suture with a fine curved needle attached

to each end, and passing the needles separately from within outwards. The eyelids should then be closed by a light compress of boric or iodoform wool. Atropine, or eserine, according to the special indications, should be instilled two or three times a day.

In cases of rupture of the sclerotic, where there is complete extrusion of the lens under the unbroken conjunctiva, no attempt should be made to take away the lens for some weeks, so that the sclerotic may have time to heal. When this has taken place the conjunctiva may be divided, and the lens let out. If, however, the lens be entangled in the wound, it should be removed as soon as possible, in order to allow the lips of the sclerotic to fall into apposition.

In penetrating wounds of the sclerotic, with lodgment of a foreign body within the globe, excision will, as a rule, be called for, unless the foreign body be a fragment of iron and so placed as to be easily accessible to forceps or to the electro-magnet.

BURNS of the sclerotic are always accompanied by corresponding lesions to the CONJUNCTIVA, CORNEA, and EYELIDS, and do not therefore call for any special notice.

JOHN TWEEDY.

SCLEROTOMY. See GLAUCOMA.

SCOTOMA, a blind spot on the retina, the result of disease. See PERIMETRY.

SCROFULA or **STRUMA** is a condition of malnutrition of the tissues; it is not a disease but a diathesis—in other words, a tendency to certain forms of diseased action, most marked in infancy and youth, yet sometimes occurring in old age, when the body is naturally less well nourished, under the name *senile scrofula*.

The causes of this condition are—(1) Inheritance; (2) bad or insufficient food; (3) overcrowding, ill-ventilation, darkness and dampness of dwelling; (4) insalubrious climate.

(1) Parents suffering from, and in a less degree those who have suffered from, scrofula and its near relation tubercle, beget as a rule scrofulous children. The degree of scrofulosis, in different members of the offspring, varies with innumerable combinations of this cause with the other causes named above; as also with the health of either or both parents at the time of impregnation, and with the condition of the scrofulous or tuberculous mother during gestation. Probably, no child of scrofulous parents is entirely free of the taint, but, if all the other

above-named conditions be absent, it may escape any local manifestation. Probably, on the other hand, it may be affirmed that a sufficiently intense combination of the above with faulty hygiene will produce scrofula, in a child of parents however healthy.

(2) The milk of a scrofulous mother certainly increases the evil she has imparted; it is even probable that suckling by a scrofulous nurse may implant the diathesis in a congenitally healthy infant. The administration of farinaceous food, before the secretion of saliva is established, has considerable influence in the production of scrofula, or at least in calling forth scrofulous manifestations. This conclusion has been forced upon the writer by observation of several cases, notably of seven in which, when such mode of feeding was stopped, the outbreak ceased. Insufficient food with excess of starch, bad quality and monotony of diet, all have, in their degree, a like effect.

(3) That overcrowding is a potent generator of scrofula is indubitable. Breathing again and again an atmosphere already exhausted by other lungs is bad enough, even if those other lungs be healthy; but recent researches render it highly probable that scrofulous emanations from one person may produce that disease in another individual. Overcrowding implies also dirt, interfering with the action of the skin, and usually causes darkness. The action of light on the body is hardly sufficiently appreciated. The effect of its absence is analogous to the etiolation of plants.

(4) Scrofula is chiefly rife in climates which, like that of Britain, are damp, cold for the greater part of the year, and always uncertain. We know, however, from history, that two and even three hundred years ago 'the king's evil' was very prevalent, and it must be, in the present day, very difficult to apportion aright its cause between heredity and other conditions. Replies, however, to the writer's inquiries show that strumous families taking up residence in America, New Zealand, and Australia, (save in overcrowded parts of seaboard towns) so lose their proclivity, that the younger members, born strumous here, cease to exhibit manifestations after emigration, and that the parents procreate healthy children.

Pathology.—The strumous diathesis, without local manifestation, possesses no pathological anatomy hitherto demonstrable; it is probable, however, that the faulty nutrition mentioned in the opening sentence consists in some want of equilibrium, structural or functional, between the lym-

phatic rootlets or spaces and the other elements of the connective tissues. Whether this want of balance be primary, or whether it be dependent on some faulty condition of blood; or again whether it produces, or is produced by, minute anatomical variations from normal texture and fabric, more especially of the adenoid constituents of tissue, is not yet ascertained. But it is certain that this diathesis, when strongly developed, is marked by certain characteristics of external form, due to peculiarities in thickness and abundance, or in fineness and paucity, of the connective (areolar) tissue; and these characteristics are more especially impressed on such parts as are largely made up of lymphoid or adenoid structures.

These peculiarities are associated with a proclivity to follow up 'any slight and transient irritation by a chronic inflammatory process, which not only outlasts the irritation, but spreads or continues independently of it, usually resulting in suppuration or caseation, and rarely assuming the form of a pure hyperplasia' (Billroth). And in these conditions it is found that lymphatic tissues, notably the glands and such parts as contain abundance of adenoid elements, are especially vulnerable. But even the parts, thus suffering from strumous inflammation, betray no anatomical peculiarities differentiating them generically from parts affected with non-strumous chronic inflammation, until the resulting products undergo certain degenerations. It is, indeed, this tendency of the inflammation to continue, while its products are averse to organisation, which constitutes the characteristic of strumous manifestations, by producing a great accumulation of the most embryonic of inflammatory fabrics—granulation-tissue. This tissue is, however, common to all forms of subacute and chronic inflammations; in struma, its persistence, and therefore its amount, is alone to a certain extent peculiar.

But here attention must be called to certain minute bodies, very apt to form in the midst of this tissue, wherever interstitial cell-growth has much exceeded the rate of vessel-formation. Thus, non-vascular islets appear in which, equidistant on every side from the great vessels, nodules, are developed consisting externally of a delicate reticulum supporting lymphoid cells; further inward, of epithelioid cells; and centrally of larger branched cells, sometimes of giant-cells. For, wherever a portion of growing inflammatory product becomes extravascular, giant-cells commonly occur. These little spots are named by Rindfleisch, 'newly-

developed lymphatic follicles.' It is possible, however, that they indicate a tendency to organisation or to fibrillation—at least an abortive attempt at those actions, for Ziegler, by placing under the skin of dogs two cover-glasses, kept so far apart as to allow of granulation-tissue insinuating itself between them, found on their removal a number of very similar spots (only he called the epithelioid cells fibroblasts) formed of exactly similar elements. These bodies are therefore in no way distinctive of struma, they are found in old indolent ulcers, in the so-called proud-flesh (*caro luxurians*) of unhealed wounds and of burns, in the granulation-tissue surrounding sequestra, and in the thick granulation-material of very chronic synovitis. Nevertheless, though not distinctive of, they are most common in struma, because persistency of inflammatory products is most usual in that dyscrasia.

But to continue the life-history of granulation-tissue, which by its very nature must be merely transitional, and if it will not organise, must of necessity degenerate. Hence, unless fibrillation or cicatrisation set in, suppuration, together with much fatty degeneration, caseation, or tuberculisation will occur.

It is still unknown whether the cause of this imperfect tissue-nutrition is intrinsic in the tissues themselves or in the blood. Some support of the latter doctrine is afforded by two facts—that the blood of a large proportion of scrofulous persons contains an undue amount of lymphoid elements (leucocytes), and that two inflammatory manifestations of scrofula are rarely simultaneous. A belief in the humoral origin of the diathesis originated its treatment by setons and issues, to exhaust the blood of its peccant material.

The *diagnosis* of scrofula, the diathesis in contradistinction to the manifestations, depends on the appreciation of certain personal characteristics which are of two types, corresponding the one to fineness and paucity, the other to coarseness and abundance, of connective tissues. The former is marked by refinement and definition of the features. The curves of the lips, the nasal, aural, and tarsal cartilages are finely modelled. The conjunctiva and sclerotic are so thin that the pigment of the choroid, partially seen through them, imparts a bluish or pearl-grey colour to the white of the eye; the skin, clear and pure of tint, with cool-toned, ash-grey shadows, is so translucent that the bluish, wavy course of subjacent veins is plainly marked, as on the

upper eyelid, the temple, angle of the jaw, &c.; the luscious redness of the lips testifies to the same condition. The eyelashes are abundant and long—a fine down, often rather long, extends from the margin of the scalp-hair some way down the forehead, temples, and nape. The whole aspect is of refined but fragile beauty.

The other type is coarse and ugly. The head large and lumpy, bigger behind than before, is flanked by large, red, puffy ears; the jaws are prominent, the lips thick, ill-defined, and often cracked, sway clumsily apart. The nose is lumpish, the origin of the alæ ill-defined, the eyelids thick and clumsy, often even when not inflamed bordered with red, are frequently lined with dried Meibomian secretion clinging to the roots of sparse irregular lashes. The dull, unclean-looking skin is marked by large orifices of sebaceous ducts. The figure is usually ungainly, the joints and extremities large, the belly prominent; the hair coarse, either of a dull sandy colour or lustreless black. These descriptions are taken from the extremes of each type; to discriminate what degree of tendency either way may justify the practitioner in considering his patient scrofulous, requires acumen and experience. His judgment will be aided by considering the family history, the age of the patient, and the kind of malady he may be required to treat.

The manifestations of scrofula affect: (1) The skin; (2) mucous membranes; (3) lymphatic glands; (4) joints; (5) bones.

(1) The scalp is especially liable to eczema, tinea, and favus; the face to lupus; scrofulous ulcers, though chiefly choosing the neck, also occur at the bends of joints. Chilblain is said to be chiefly common in strumous persons, probably an error due to the obstinacy of all inflammations in such individuals.

(2) Phlyctenular ophthalmia, ulcerative corneitis, tinea tarsi, chronic catarrhs, catarrhal bronchitis, enlargement of tonsils and thickening of pharyngeal adenoid tissues, persistent coryza, ozæna, otorrhœa, purulent vulvitis and vaginitis.

(3) Enlargement of lymphatic glands, chiefly of the neck, probably induced in the first instance by teething, by one or more of the above irritations, or by an exanthem, especially by measles; thus every instance of an enlarged cervical gland is not, of necessity, strumous. The characteristics of the scrofulous enlargement are its very chronic character, its continuance long after the causation has ceased, its spread from gland to gland, and the tendency of the glands to

attain considerable size and to be the seats of protracted suppuration.

(4) Most chronic joint-affections, arising between the ages of a few months and eighteen years, are scrofulous, though they may originate (as some believe) in slight traumatism. The affection may commence in the synovial membrane, in the epiphysis, or in the epiphysial junction; in the last two conditions, the hyperæmia of rapid growth affording the primary irritation.

(5) Chronic carious affections of the bones occurring during early life are very generally strumous, absence of syphilis being verified. Spongy bones, as the bodies of vertebræ, the small bones of the carpus and tarsus, the epiphyses of long bones, are peculiarly prone to such affection; the hard cortex of long bones is less often attacked. A peculiar enlargement or distension from within of one or more phalanges bears the name of dactylitis; it is generally strumous, sometimes syphilitic. Rachitis is probably a scrofulous affection in the large majority of instances.

The combination of scrofula and syphilis is by no means uncommon; the manifestations of the mixed diatheses are severe and obstinate. Some writers believe that scrofula is degenerated syphilis, an unproven hypothesis.

The *treatment* of the scrofulous diathesis (the treatment of the above manifestations falls each under its own heading) is first of all improved hygiene, including—residence in large, not over-filled rooms, in preference by the seaside or at a somewhat high elevation on a dry gravelly soil, good ventilation, plenty of light and outdoor exercise. The diet must be regulated according to the age of the subject, and for that age must be of the most light and wholesome description. In the refined delicate forms, fatty matters should especially be pressed; ale or stout also may be given; they are less valuable, sometimes inadmissible, in the other form.

In the administration of drugs a similar distinction is desirable. The former kind of struma indicates cod-liver oil, maltine, iron—what may be called the blood-making tonics; the latter quinine or other bitters, mineral acids (nitro-hydrochloric), iodide of potassium; if iron be employed it should be given as the iodide. Alkalies, when the breath is sour, are often valuable. In this form of the diathesis, an occasional purge and alterative are essential to the treatment, especially when phlyctenular ophthalmia or the other above-named eye-affections are present, while the breath has an evil odour.

RICHARD BARWELL.

SCROTAL ELEPHANTIASIS.—The general subject of elephantiasis having been fully discussed elsewhere (*see* ELEPHANTIASIS ARABUM), it only remains here to consider the disease as specially affecting the scrotum, and to describe the measures which have been adopted for the cure of scrotal tumours of this nature.

Several varieties of the disease, as affecting the scrotum, are met with in India and other places where this malady is rife. They may be included in the following categories:—

1. Solid hypertrophies of the external genitals. These may be subdivided into:

(a) Simple scrotal elephantiasis. In most cases both penis and scrotum are implicated, but in some cases (i.) the skin of the penis and the prepuce are mainly involved, the scrotum being less affected; and in others (ii.) the scrotum is the principal or sole seat of disease. Under this head also come (iii.) labial tumours in the female. The labia majora are the most common seat of the disease, but the prepuce of the clitoris and the labia minora are also sometimes thickened. In rare cases, the tumour is principally situated in these latter parts.

(b) Complicated scrotal elephantiasis. The complication may consist of—(i.) Abscesses and ulcers; (ii.) stricture of the urethra; fistulæ, urethral, perineal, and anal; (iii.) large hydroceles and hæmatoceles; (iv.) hernia. These local complications materially affect the question of operation. (v.) The tumour may be in a state of acute hyperæmia, with accompanying fever, or (vi.) there may exist diseased conditions of the spleen, liver, kidneys, bowels, or adjoining lymphatic glands, or some constitutional disturbance or cachexy. These general complications also raise a doubt as to the propriety of resorting to operation.

2. Condylomatous growths simulating elephantiasis—met with both in male and female subjects.

3. Warty growths implicating the prepuce, penis, or scrotum, that have attained such a size as to constitute a tumour, or associated with some elephantoid thickening, also met with both in males and females.

4. Serpiginous ulcerations, consequent on chaneroid, and usually accompanied by some degree of elephantiasis.

5. Lymph-scrotum, consisting mainly or wholly of dilated lymphatic vessels, exuding spontaneously or on puncture a clear or milky fluid. The penis often remains healthy in this variety. Filarie are found

in this class of cases, but in none of the others. This form of disease is rarely, if ever, met with in the female.

It may be laid down, as a result of wide experience, that medicinal appliances are of little or no service in any of these forms of disease. A certain amount of relief may be obtained by recumbency, elastic bandages, and the local and general use of absorbents, more especially preparations of iodine; but, though the size of the tumour can be reduced by such agencies, the disease cannot be cured, and progressive enlargement will be found to proceed by means of those periodical attacks of fever, accompanied by local congestion and exudation, which characterise the development of the disease. It has also been established by a very large experience in India, China, and elsewhere, that by means of operation the local disease can be removed and the periodic fever which is associated with it cut short; and this without sacrifice of the essential organs of generation, or, in the great majority of cases, any risk of recurrence.

The questions which demand consideration here, therefore, are (1) in what circumstances is recourse to operation justifiable or desirable; and (2) what is the most approved and successful method of operating.

The inducements to remove the diseased parts by operation are these:—(a) The deformity and inconvenience caused by the growth, especially when it has attained a large size; (b) the sexual disability which it entails; (c) the discomfort caused by the periodical recurrence of fever; (d) the impairment of general health which results from these repeated attacks of pyrexia, which are often of severe character, and from the visceral disturbances, functional and structural, which are apt to be associated with a long-standing and progressive elephantiasis, and which undoubtedly tend to shorten life.

The earlier the tumour is removed, when it has once been fairly developed, the better, because the removal of a mass of moderate size, in a comparatively young subject, is a much less risky proceeding than the amputation of a large tumour in an old subject. Besides, the constitution and vitality of the subject are conserved by cutting short the fever, and preventing the development of visceral disturbance or decay.

The *contra-indications* of operation are:

a. *Old age.*—In the aged, sexual disableness is not a matter of much consequence, and if the tumour has, as often happens, become stationary in its growth, and the concomitant fever ceases to occur

or becomes less frequent and severe, operative interference, which is always more hazardous in the old, should be considered with more hesitation and caution.

b. Ill-health and visceral disease—more especially of heart, kidneys, or intestines. A weak or damaged heart, albuminuria, and chronic diarrhoea or dysentery, are prohibitive of operation. Cachexia and anaemia, however caused, also constitute serious objections to operating, and diabetes is absolutely prohibitory. Recent and acute enlargements of spleen and liver are likewise prohibitive, but chronic enlargement of either organ, if not accompanied with manifest impairment of health, is not a bar to removal by the knife.

c. Complications.—Reverting to the list of these given above—(i.) If the abscess be acute, it should be treated and cured before operation is resorted to; if chronic, or dependent on hæmatocele or diseased tunics, it may safely be removed along with the tumour. If the ulcer be small, and due to local irritation, or preceding abscess, operation need not be delayed. If large and due to general ill-health or extensive sloughing, caution and delay are advisable. (ii.) A stricture should be fully dilated before the operation is resorted to, because there is often difficulty in passing urine for a few days, and the use of a catheter is by no means an easy and safe matter unless the urethra is of normal size. Fistulae should, if possible, be cured by dilatation of the urethra or by free incision, accompanied, if necessary, by urethral dilatation; and, if they cannot be closed, operation should be declined. (iii.) Very large hydroceles and hæmatocèles enhance the risk of the operation, but are not a bar to it. If the patient is very old, the propriety of interference is more than doubtful; but in young and middle-aged subjects operation is advisable, and both diseases can be radically cured by the same procedure. (iv.) The existence of herniæ imports a very serious risk to life, and the simultaneous performance of an operation for the removal of the tumour and cure of the rupture has been proved, by experience, to be a very perilous practice. (v.) Operation should never be resorted to when the tumour is in a state of excitement, or while any febrile constitutional disturbance exists. Large size does not constitute so strong an objection to operation as some of the other considerations which have been adduced; for though it is true, generally, that the danger of removal is directly proportionate to the bulk of the mass, still, under improved methods of

operating, the risks depending on size have been greatly reduced, and experience has proved that immense tumours of this description, weighing, after removal, from 100 to 120 lbs., may be easily and successfully amputated, the period of convalescence and ultimate result being much the same as in the case of smaller masses.

The removal of scrotal elephantiasis has been practised in India since the beginning of the present century, and, at the present time, operations for this purpose are unhesitatingly performed in all countries and places where the disease is met with. The mortality in uncomplicated cases is inconsiderable, and the relief conferred complete and permanent. At first, the operation partook of the character of an amputation rather than a dissection. A clean sweep was made of the whole mass, including the genitals, at the level of the pubes, the vessels being tied as rapidly as possible, and the wound allowed to heal by granulation. Some surgeons transfixed the base of the tumour with a long catlin, and cut flaps from each side of its neck.

Rapidity of execution was considered to be the main point, for the double purpose of saving suffering and blood. Gradually, attempts were made to save the sexual organs. The penis was dissected out, and in small tumours the testes, when they appeared to be healthy; but, when the tumour was large and the testes diseased, no attempt was made to isolate and preserve them. The use of anæsthetics and of appliances for preventing hæmorrhage has allowed greater deliberation to be practised, and it is now very seldom necessary to sacrifice the testes, either on account of the size of the tumour or of disease of those organs. A curious attempt was made in the years 1836-39 by Dr. Esdale, of the Indian Medical Service, to induce anæsthesia by means of mesmerism, and a hospital was organised in Calcutta for the purpose of carrying out his experiments. The annals of this institution are exceedingly interesting, and appear to establish the fact that operations can be painlessly performed on mesmerised subjects. The process of mesmerising was, however, tedious and uncertain, and the introduction of chloroform rendered further experiment unnecessary.

The principles in accordance with which the operation is performed, in the present day, are as follows:—

1. To empty the tumour as completely as possible of blood.
2. To prevent bleeding during the operation.

8. To remove every scrap of diseased tissue and of tissue likely to become diseased.

4. To preserve the essential organs of generation.

5. To secure the testes in proper position by catgut-stitching.

6. To prevent putrefaction in the wound.

A few observations on each of these heads will suffice to describe the steps of the operation.

1. Elevation and elastic bandaging are the measures employed for anæmiating the tumour, and they are perfectly competent to do so. Ten to twenty minutes, according to the size of the mass, are sufficient for the purpose.

2. To prevent bleeding during the operation, an elastic cord should be tightly applied round the root of the tumour before the removal of the bandage, and secured in its position by being attached by tapes to a waist-belt. An easier and equally efficient plan is to take an elastic cord about three feet long, pass the centre of it round the loins, bring the ends over the brim of the pelvis, cross them twice over opposite sides of the neck of the tumour, and, finally, bring these together below the navel; the neck of the tumour will thus be tightly embraced by two turns of the cord on each side, crossing each other on the pubes and just in front of the anus.

3. Experience has proved that if any portion of the diseased tissue be left behind, recurrence is almost certain to take place. Even although the prepuce appears to be healthy, it should be removed close to the corona glandis; and as thickening is peculiarly apt to commence in the raphe of the perineum, that part should in most cases be freely removed by a V-shaped incision up to the verge of the anus. If any attempt is made to cover the penis or testes with flaps, these should be taken from the skin of the abdomen or thighs, and not from the neck of the tumour; but a satisfactory result can be secured in all cases without resort to flaps, which are prone to slough or suppurate and to initiate septic disturbance of the wound and constitution.

4. The first step of the actual operation consists in decorticating the penis. A director is passed into the preputial cavity as far as the reflexion of its lining membrane on to the corona glandis, and, by means of a strong bistoury, the prepuce is slit open by transfixion and cutting upwards. An incision is made from the root of the penis on its dorsum to meet and complete this cut. The penis is then freed by finger and

knife, the mucous membrane of the prepuce being carefully detached at the line of its reflexion. The isolation of the penis is completed as far as its suspensory ligament, which should not be injured. A vertical incision is now made from the pubes to the fundus of the tumour, over one cord and testis. By successive bold strokes these are exposed, and then dissected out by fingers and knife, and subsequently held out of the way by an assistant. The other testis is similarly dealt with. The three vertical incisions are then connected at their pubic terminations by two transverse cuts, which must be beyond the limit of the diseased tissue. A circular or oval incision is now made round the rest of the circumference of the neck of the tumour, and by rapid strokes the whole mass is removed. Vessels are now looked for. The largest will be found in the centre of the perineum and on each side of the pubes. By gradually loosening the cord, others will be observed to spring. All bleeding points should be carefully secured, and as many as thirty to forty ligatures may be required. The parts may now be trimmed if, in the hurry of operation, any diseased tissue has been left behind; and if the tunics are redundant or thickened, as much of them should be carefully dissected off as can be done without endangering the vitality of the testes.

5. The testes may now be stitched together by means of prepared catgut, and fastened in proper position by a few tacks of the same material. Depressions or pockets can be very easily made for their reception, by separating the deep layer of the superficial perineal fascia from the subjacent fat and areolar tissue. The skin can then be drawn over them from each side to a considerable extent, by means of a continuous catgut suture.

6. The prevention of putrefaction in an extensive wound, from which there is necessarily a very profuse discharge, situated in such close proximity to the urethral and anal orifices, and to which it is difficult to maintain dressings in close contact, is by no means an easy task.

The use of the spray during operation, or of thorough irrigation with carbolic or sublimate lotion immediately after it, and the dusting of the wound with iodoform, followed by the careful application of antiseptic dressings, suffice in most cases to maintain asepsis and to prevent suppuration. The plan of dressing employed by the writer is—(1) The application to the raw surface of boracic ointment spread on thin gauze; (2) placing outside of this

a piece of boracic lint sufficient to overlap the whole wound and a margin of skin beyond; (3) outside this are applied folds of carbolic gauze, which extend beyond the margins of the wound on to the pubes and thighs; (4) a sheet of waterproof or oiled paper is spread over the dressings, and the whole secured by careful bandaging. The dressings are changed daily for the first ten days or so, while the discharge is profuse and the wound large; then every second or third day, as the wound contracts and the exudation from it diminishes.

The process of repair consists in the filling up of the wound-cavity with lymph, which glazes the wound and forms a medium of union between the testes, and between these and the surface of the perineum. When this lymph undergoes vascularisation and organisation, granulations form and cicatrisation advances over the wound from the borders of the divided skin and preputial mucous membrane. The process of repair is tedious, occupying from six weeks to two months. Care must be taken to keep the penis free, as it is apt to be embedded in and retracted into the mass of granulation-tissue. Should such a result threaten, the granulations at its root may be broken down by the finger-nail, or divided by scissors if they have become firm. The ultimate result of the operation is, in the great majority of cases, satisfactory. Skin is dragged by the process of cicatrisation from the thigh to form a seemly and useful substitute for the amputated scrotum, and the penis acquires a fresh covering of cicatricial epidermis. The sexual functions are restored, and both health and comfort re-established.

The operation above described is applicable to all the forms of elephantiasis which have been specified. If the skin of the penis is quite healthy, the scrotum may be removed alone by a circular incision round its neck, the testes being dissected out as the incision is deepened.

Labial tumours in the female are removed in accordance with the same principles. If very large, their base may be transfixed and tied with whipcord before amputation is commenced; but, in most cases, the prompt use of *forci-pressure* forceps and sponge pressure suffice to prevent much loss of blood. The edges of the skin can be approximated or brought into contact by sutures, and the process of repair thus very materially shortened. K. McLEOD.

SCROTAL SWELLINGS, Diagnosis of.—In the examination of a scrotal swelling certain points must be kept clearly in

view, and this may be done by the surgeon asking himself the following questions:—Is this swelling a scrotal one proper, or does it extend into the inguinal canal or abdomen? Is it reducible or no, and, if reducible, is this real or only apparent? Is it fluid or solid? What are its relations to the testis, epididymis, or cord? Is any part of it translucent? Is it of the same consistence all over? What has been its rate of progress?

Scrotal swellings may be divided into: (a) those which occupy more or less of the inguinal region as well as the scrotum, and (b) those confined to the scrotum.

(a) The chief swellings here are:—1, scrotal hernia; 2, scrotal hernia with hydrocele; 3, infantile hydrocele; 4, congenital hydrocele (occasional); 5, hydrocele of cord (occasional); 6, incompletely descended testis; 7, large varicoceles (rare); 8, combined hydroceles—e.g. of the tunica vaginalis and of the cord (rare); 9, new-growths of the cord—e.g. lipomata, malignant (still rarer).

The method of handling any scrotal swelling is important. The left hand should take hold of the upper part or neck of the swelling, so as to steady the tumour; then any impulse on coughing can be felt for, and, at the same time, by a gentle downward squeezing movement, the rest of the swelling is pressed forward, and the scrotal tissues over it stretched, the fingers of the right hand being free to percuss, or otherwise examine into the nature of the swelling.

1. *Hernia* is one of the commonest scrotal swellings, being met with in children as well as later on in life. It may be known by the impulse at the neck, its ready reducibility (usually) on the patient's lying down, with slip or gurgle, the facility with which now the external ring and cord can be felt, its speedy descent when the patient stands up and coughs, and its lack of translucency. The thickened tissue felt in the scrotum after the return of the hernia is merely the sac, and not to be taken for anything more abnormal. If the hernia is irreducible, there will still be impulse, the feeling of coils of bowel or of granular omentum; and the irreducibility will be either temporary—due to neglect of the bowels or disordered digestion—or permanent, owing to repeated 'bowel attacks,' accompanied by slight colicky pains.

2. A hernia is frequently complicated with hydrocele (see below).

3. *Infantile Hydrocele*.—A sub-variety of the congenital, in which the fluid usually extends as far as the external abdominal

ring. Its smooth outline, transparency, and history are main points, while its irreducibility, and fluctuation without gurgling, distinguish it from hernia.

4. *Congenital Hydrocele*.—This is dull on percussion and translucent, the impulse is much less distinct; its reduction is generally perfectly easy when the patient is recumbent, but occasionally requires steady pressure; it is unaccompanied by any slip or gurgle unless a congenital hernia is also present.

5. *Hydrocele of the Cord*.—The fluid here is usually encysted, and is most frequently due to part of the processus funicularis remaining unobliterated, more rarely to some independent collection of fluid becoming encysted in the connective tissue of the cord. In the former case it will have been noticed from birth or from early childhood, in the latter it may date from an injury or strain. The swelling is often mistaken for a hernia, and a truss ordered. The following are the chief distinguishing points:—Usually oval in shape, the swelling is found to be limited above and below—i.e. when drawn down it has no neck; so, too, when drawn down, the impulse is less and less distinct. It cannot be completely and distinctly returned; though often tense, fluctuation can sometimes be made out; and by using a candle in a dark room and lifting the swelling up, translucency can usually be observed.

6. A *retained testis* often forms a swelling in the groin or upper part of the scrotum. Its shape, sensitiveness, mobility, and the empty scrotum are decisive. If retained in the inguinal region, a testis may be the seat of orchitis in recurrent crippling attacks. Some of these may be so acute that the swelling may simulate a strangulated hernia. Thus the attack may have come on after a strain, the patient persisting in his statement that he has always had a rupture which came down and went up again. The parts are exquisitely tender, and do not admit of handling; most acute pain may be present in the lower part of the belly, accompanied by nausea and constipation. On careful examination the scrotum is empty, no truss has ever fitted, the rupture has never been really reducible, and unless peritonitis be present, which is not common, the symptoms will be less urgent than those of strangulation; thus the vomiting will not be more than bilious, and flatus at least will be passed. If, after a few hours, treatment does not clear up the case, the diagnosis should be made certain by antiseptic exploration.

A testis retained in the inguinal region is liable, after repeated attacks of inflammation, to become the seat of malignant disease, and form a swelling in the groin and upper part of the scrotum. It will be known by the absence of the testis from the scrotum, the history of repeated inflammatory attacks, the steady increase in size, and painfulness of a swelling, which, chiefly solid, shows fluid at one or more spots. Lastly, the absence of a testis from the scrotum will prevent the surgeon from mistaking a retained testis, which is the site of acute epididymitis, for a bubo.

(b) The chief scrotal swellings proper are:—1, hydrocele (vaginal and encysted); 2, hæmatocele; 3, orchitis; 4, syphilitic testis; 5, epididymitis; 6, strumous testis; 7, new-growths; 8, varicocele.

1. A *vaginal hydrocele* is known by the absence of impulse, by its pyriform shape, fluctuation, and almost unvarying translucency. The testis is at the back, as shown by its sensitiveness and opacity. The increase has been slow, painless, and usually occurs in patients of middle or later life, though it is not uncommon in younger men after strain, injury, or in association with acute epididymitis.

An *encysted hydrocele* is recognised by its position to the outer side of, and rather anterior to the testis, its fluctuation, its shape—globose rather than pyriform—and much slower growth.

Swellings in which different hydroceles are combined—e.g. one of the tunica vaginalis and an encysted hydrocele—are met with, and may at first be difficult of diagnosis. A very common combination is hydrocele of the tunica vaginalis with scrotal hernia, and in the later stages of this combination, when the two swellings have come into close contact with each other, the diagnosis is a matter of some doubt at first, especially when the hernia is irreducible; but if attention is paid to the points already given, there will be no real difficulty.

2. A *hæmatocele* will be known, when at all recent, by its rapid onset after a blow or the tapping of a hydrocele; its condition, at first fluid, then more solid; its weight and want of translucency, and the position of the testicle at the back. A little later, especially if the patient get about, tenderness, redness, and cedema of the scrotum will point to an inflamed hæmatocele.

3. *Orchitis*, or inflammation of the testis itself, may be met with as an acute, sub-acute, or chronic affection. The acute is usually due to a blow; it is rare, though epididymitis (owing to some urethral cause)

is often called orchitis. Subacute orchitis may be due to a blow, the congestion which goes with ungratified and unrestrained sexual desires, or it may occur in the course of an attack of gout or mumps.

Chronic orchitis may be confused with an old hydrocele, hæmatocele, or some of the new-growths of the testis.

4. *Syphilitic orchitis* may present itself as a diffuse chronic inflammation of the testis two or three years after contagion, or later on as a gummatous affection, or the two may be combined. In the former, the swelling may reach the size of a large egg or small orange, the smooth heavy mass being devoid of testicular sensation; both testes may be affected. In the gummatous orchitis the enlargement is less, and the surface may be knotty. Both are insidious, both may be accompanied by subsequent wasting.

5. *Epididymitis*, in its acute and subacute forms, is one of the commonest of scrotal swellings. Its diagnosis will be aided by remembering that it is nearly always due to some urethral irritation, most frequently gonorrhœa. It shows itself as a rapidly forming swelling, acute and tender, at the outer and back part of the testis, from which at first it is separated by a distinct furrow. The swelling is flat-sided, the scrotal tissues red and a little cedematous, and some fluid is usually present in the tunica vaginalis. Nausea, chilliness, pyrexia accompany it, and probably some deep-seated pain has been noticed creeping along the inguinal region and cord, and the vas deferens is thickened and tender.

6. *Strumous testis*.—This obstinate affection usually begins as a painless insidious nodule in the head or tail of the epididymis, which tends ultimately to soften and gradually to perforate the scrotal tissues which have become adherent to it. The condition of other parts—the testis, vas deferens, and prostate—should be examined into for thickening and enlargement: the bladder for cystitis, and the kidney for any evidence of strumous pyelitis. A history of chronic inflammation of joints and glands, or of phthisis, will aid in the diagnosis.

7. *New-growths of testis*.—Where these are rapid in their growth and results, as in the case of encephaloid carcinoma or round-celled sarcoma, the diagnosis is not difficult; but where the progress is slow, where for some time the consistency keeps firm, the cord is not involved, and the patient's health remains good, as is often the case in a spindle-celled sarcoma, a chondro-sarcoma, or in the earlier stages of 'cystic disease

of the testis,' the diagnosis is by no means so easy, especially as the history of repeated slight injuries may suggest orchitis. See TESTIS, Diseases of the.

8. *Varicocele*.—This, one of the commonest of the affections in the scrotum, will be known by the soft, worm-like, bluish coils of enlarged veins around and along the cord, the relaxed scrotum, and the dropped testicle. When extending into the canal, a varicocele shows impulse when the patient coughs; but this is less distinct than in hernia, and alteration in the size of the swelling is only noticed when the patient has been on his feet or resting for some considerable time. It is not completely reducible, and if the surgeon, having got up all he can while the patient is lying down, place his finger over the external abdominal ring, and tell the patient to rise, the swelling gradually reappears below the finger.

W. H. A. JACOBSON.

SCROTUM, Injuries and Diseases of the.—*Contusions* may occur from falls on the edge of a chair, on a rail, pommel of saddle, &c, and owing to the looseness of the tissues, much extravasation may take place. This is often complicated with hæmatocele, but, if existing by itself, may be known by its superficial position and its crossing the scrotal raphe.

Treatment.—In severe cases absolute rest in bed should be enforced, and the scrotum be kept well raised by a suspensory bandage and a small firm pillow. A smart purge should be given, and its action gently kept up, and a cooling lotion—lead, or lead and opium—constantly applied. Where the coexistence of a hæmatocele is suspected, ice should be applied, but, except in strong and healthy subjects, it will be well to place a layer of lint next the skin. If the ice does not produce material relief within two hours, its use should be discontinued, and lotions, at first cold, then warm, gradually substituted, in order to prevent too rapid changes and sloughing of the scrotum.

If, later on, any thickening of the scrotum be left, it will be well to rub in oleate of mercury (5 p.c.), or to use counter-irritation by iodine.

Wounds.—These may be incised or lacerated, the results of falls, machinery accidents, or attempts at mutilation. In the case of a recent incised wound, after cleansing the parts and arresting hæmorrhage, it will be well, owing to the disturbing effect of the dartos, to draw the edges of the skin together with fine silk sutures, not passing them sufficiently deeply to

open up the cellular tissue. Before inserting these, the testicles, if protruding, must be carefully replaced, and the scrotal tissues relaxed by warmth. Cold lotions should be applied after insertion of the stitches, and the parts be kept well supported to prevent any bagging and strain on the stitches.

In lacerated wounds, stitches must be used with great caution and only in a recent case, a few points of fine silk being employed. Warm lotions, cotton-wool, and even support are here indicated, any stitches used being removed early, and punctures made on the appearance of œdema.

Edema, Cellulitis, and Erysipelas of the Scrotum tend to run into and complicate each other. They occur chiefly in infants, especially weakly ones of lowly life, and in adults when depressed in health, ill-fed, and exposed to cold, and often in the subjects of visceral disease. The exciting cause is injury, or a much slighter matter, a patch of erythema, an abrasion, fistula, or even merely the trickling of urine. The chief dangers are, in the case of infants, peritonitis, if the processus funicularis be patent, and, at any time of life, sloughing and septicæmia. The scrotum and skin of the penis are, no doubt, well supplied with blood, but the vessels come from a considerable distance, are flexuous, and but ill-supported in the necessarily yielding cellular tissue of the parts, the meshes of this tissue being, furthermore, easily loaded with inflammatory products.

Cases of œdema, cellulitis, and erysipelas of the scrotum are to be carefully distinguished from those of extravasation of urine, which they closely simulate, by the absence of any previous urinary trouble, and by the facility with which a catheter can be passed. The history of a painful, localised swelling in the middle line—e.g. a perineal abscess observed before the appearance of the more general swelling—will also be absent. As long as the œdema or redness is slight, elevation of the parts, keeping them very dry and dusted with zinc and starch powder, will be sufficient, locally. A little later, multiple punctures will probably be required, and when the parts are not only tense and glossy but brawny, free incisions should be made into the cellular tissue. In making these, it should be remembered that the vitality of the parts is already seriously impaired, and that needless incisions will not only, by further interfering with the blood-supply, increase the liability to sloughing, but may also excite further diffuse inflammation. For this reason punctures will probably be sufficient

in children, and in adults it will not be needful to make more than two incisions on either side, one close to the raphè, about three inches long, carried well down into the lower and posterior part, and another somewhat shorter and external to this. The hæmorrhage will at first be free, but if any spurting vessels are twisted or ligatured, the oozing will be checked by pressure applied by a pad of lint and carbolic oil, over which iodoform and tannin have been dusted. Later on the carbolic oil may be replaced by saturated lotions of boracic acid, or an ointment of vaseline ʒj., ol. eucalypt. fʒj., iodof. ʒj.; prominent or weakly granulations being treated occasionally with lotions containing copper sulphate or nitric acid. The general treatment requires to be of a supporting kind.

Sloughing and Gangrene may follow on erysipelas of the scrotum, quite independently of any extravasation of urine, its most frequent cause. Other, but much rarer causes, are frostbite and the exhaustion of prolonged exanthemata. The changes in colour and temperature are quite unmistakable.

If there is no evidence of lesion requiring incisions, the part should be kept well wrapped up in cotton wool, in which a little powdered iodoform has been dusted, lint soaked in eucalyptus or carbolic acid oil, or poultices of yeast, charcoal, or chlorinated soda made use of, it being remembered that, as in other cases of gangrene, poultices, to do any good, must be changed frequently, and that this has the disadvantage of entailing frequent exposure. Later on, sloughs should be clipped away, and stimulating dressings, such as resin and tinct. benzoini co. made use of, and healing hastened by occasional applications of silver nitrate (gr. x.—fʒj.), and skin-grafting. The reparative power of the scrotum is well known; very large losses will be replaced, though the skin is now thinner, smoother, and less supple than before. Sloughing of the scrotum, and the milder inflammatory affections which may precede it—e.g. œdema and erysipelas—are usually accompanied by symptoms pointing to asthenia, and the treatment should be, from the first, supporting.

New-Growths in the Scrotum.—Of these epithelioma is the most common—‘chimney-sweep’s cancer’—though this disease is on the decline, owing, probably, to the use of machines in chimney-sweeping.

It usually begins as a small wart on, or as a pea-like swelling in, the skin, the disease starting in the latter case from the

irritation of a sebaceous gland or hair-follicle. In either case induration and ulceration follow sooner or later, though often insidiously, the ulceration presenting the characters of epithelioma elsewhere, viz. edges indurated, everted, and sinuous, the base of uneven depth, here greyish and sloughing, there prominent with unhealthy granulations. If left to itself, the ulceration may go so far as to expose and destroy the testicles, and involve the glands in the groin in large malignant ulcers.

Treatment.—This should be always early and free removal by the knife, aided, if need be, by caustics, such as zinc chloride and flour. As an aid to removal, a metal catheter may be kept in the urethra, and if the testicles are involved leave should be got, before the operation, to extirpate them if necessary. The inguinal glands, if merely enlarged, not densely hard, and if still movable, may be watched for a while. Where removal of the disease is not possible, the surgeon can only support the strength, relieve pain, and diminish fœtor.

A few other scrotal new-growths are very occasionally met with, viz. fibro-cystic, fatty, and fibrous; these last, though originating in the scrotum, often becoming attached to the epididymis or testis.

W. H. A. JACOBSON.

SCURVY.—This is a non-febrile general disorder due to defective diet, which is manifested by the ordinary symptoms of debility, by certain scattered lesions caused by effusion of blood or fibrin, and probably by degeneration of muscles and other soft parts. These conditions are always associated with, and doubtless result from, certain changes in the composition and physical properties of the blood. Though it has long ceased to be endemic, and may now be regarded as a rare affection, scurvy is still liable, as was proved during the siege of Paris in 1871, to break out under certain conditions, and to attack large masses of people.

The symptoms of scurvy in its latest attacks differed in no respects from those described by Lord Anson and by Bachstrom, Trotter, and others in the course of the last century, and the forms of the disease, still occasionally observed in crews of merchant vessels, differ only in degree from those formerly described as typical instances. It has been shown by most recorded observations that the essential cause of the scorbutic condition is abstinence, more or less prolonged, from certain succulent vegetables or fruits in a fresh state, or from their pre-

served juices. It is very evident, however, that scurvy, in its origin, course, and intensity, may be influenced to a considerable extent by other conditions. In a group of individuals deprived of vegetable elements of diet, some will remain free from any scorbutic taint, if not altogether, certainly for a long time, whilst others will present well-marked symptoms at an early period.

The conditions tending to resist an attack of scurvy are good general health, sufficient and proper nourishment, and fair hygienic surroundings. Opposite conditions to these, and such as cause general debility, degenerations of tissues, and alteration in the composition of the blood, favour the scorbutic attack, and often do this so markedly that some have been regarded not merely as predisposing, but also as essential causes of the disease. The most frequent of the many faulty conditions that favour an attack of scurvy in the absence of vegetables, is a generally poor and defective diet, especially a want of fresh meat. Conditions to which much importance has been attached, and which have certainly existed in many recorded instances of sea scurvy, are those of prolonged exposure to wet and cold, and of overcrowding in damp and confined quarters. Other very favourable conditions are chronic disease attended with exhausting discharges, and convalescence from some severe and acutely febrile affection. In instances of scurvy on board ship, the first, and often the sole members of the crew to become affected, are usually the subjects of dysentery, syphilis, or chronic rheumatism. Extremes of climate, both heat and cold, have been regarded as favouring conditions, and also prolonged absence of the sun's light. There can be no doubt that prolonged service in the tropics on board ship, under bad hygienic conditions and with indifferent food, predisposes to scurvy. The fatigue caused by extreme and prolonged muscular exertion has been regarded by many as another favourable condition; whilst, on the other hand, it was asserted by Lind that there is a special predisposition to scurvy in those who, through indolence or enforced confinement, take but very little exercise.

Notwithstanding the important part played by one or more of the foregoing conditions, in most instances of outbreaks of scurvy there seems to be no sufficient reason for regarding any of them as essential causes of the disease, or as capable of producing it, so long as the dietary includes proper vegetable food. It still remains to be proved, by well-observed and properly

tested instances, that scurvy can occur in the absence of such elements of food, or that an abundant supply of fresh meat, of milk, or of blood can, during a prolonged failure in the supply of fresh or preserved fruits or vegetables, or of the juices of succulent vegetables, protect against a scorbutic attack. The long-maintained freedom of the British and foreign navies, and the records of recent outbreaks on board ship, and in campaigns and sieges, help to prove the point argued by Dr. Parkes, in 1848, that 'true scurvy is caused by a deficient supply of the organic vegetable acids, or salts of fresh vegetables.'

The subject of scurvy is usually listless and depressed, and, from the beginning of the attack, complains of stiffness and of 'rheumatic' pains in the lower limbs. In most cases he suffers from pleurodynia, and also much pain, with a sense of constriction, in the region of the heart. The pulse is slow and feeble, and there is a decided tendency to syncope, which, in severe cases of scurvy, may be brought on readily and prove fatal in any attempt at active exertion or change of position on the part of the patient. The temperature in most instances is normal or slightly subnormal. Except in extreme and complicated cases, the action of the bowels is very sluggish. The urine is usually pale, clear, and abundant in the early stages; as the disease advances, it becomes scanty and high-coloured. There is very rarely any hæmaturia; in some few cases—according to Hayem in about one-fifth—there is transient albuminuria. Chemical examination of the urine indicates, according to Dr. Ralfe, a chemical alteration in the quality of the blood, consisting in a diminution of its alkalinity, due to an increase of acid salts and a withdrawal of alkaline salts—chiefly alkaline carbonates. The skin becomes dry, harsh, and wrinkled, and presents a characteristic pale yellow colour. The mucous membranes of the lips, eyelids, and hard palate are usually very anæmic. Occasionally, the skin of the lower lid and adjacent part of the cheek is puffy and of livid tint. The dorsal surfaces of the hands and feet sometimes become œdematous, but beyond these indications there is very rarely any dropsy. The characteristic signs of scurvy are the petechiæ and patches of ecchymoses presented by the skin, and the swelling of the gums. The skin of the lower limbs and, in late stages of severe cases, that of the upper limbs and front of the trunk is marked by numerous small petechial spots, varying in tint from pink

to deep red or deep brown, each of which is traversed by one of the hairs. In addition to these are larger, irregularly shaped, livid patches resembling small bruises. A common symptom of scurvy is extensive subconjunctival hæmorrhage.

In the subcutaneous cellular tissue, mostly in the lower limbs, are larger patches of diffused extravasation, which are manifested on the surface by pale blue mottling. More deeply situated under the deep fasciæ, and within the sheaths of muscles, are the so-called 'scorbutic indurations,' large masses of effused blood or blood-stained fibrin, which form hard, indistinctly circumscribed, and very tender swellings. These are most frequently observed at the back of the lower limb along the muscles of the calf and ham, and in the space between the tendo Achillis and the bones of the leg. In the former case the leg is flexed and cannot be fully extended, and movement at the knee is much restricted. The breath of a scorbutic patient is very foul, and in most cases, in the adult subject, the gums both in front of and behind the teeth will be found covered by soft fungous growths of a deep red colour, which are very vascular, and bleed readily when touched. These, like most of the other superficial lesions of scurvy, are probably due to local irritation. They are largest and most abundant about the necks of carious and dirty teeth, and in patients with sound and well-cleaned teeth are very often absent. It has been asserted that the gums of edentulous patients are never thus affected. The larger joints, the knees most frequently, are occasionally implicated in the manifestations of scurvy, becoming swollen and painful in consequence of an intra-articular effusion of a more or less blood-stained serous fluid. A frequent deep-seated lesion is the scorbutic node, formed by the deposit of a layer of organisable fibrin under the periosteum of a long bone, most frequently the tibia. Hemeralopia, as has been pointed out by Blane and Bryson, and also by some French naval surgeons, occasionally occurs in association with scurvy, and, in most of the instances, disappears simultaneously with the special scorbutic symptoms, after improvement of the diet. This affection, however, is very probably not a manifestation, but simply a concomitant of scurvy, and due to general poverty of diet rather than to absence of fresh vegetables.

In the advanced stages of severe scurvy, the superficial patches of ecchymosis in-

crease in number and extent, bullæ containing blood are formed on the surfaces of the limbs and trunk, and an increasing hæmorrhagic tendency is indicated by epistaxis and hæmatemesis, and by a discharge from the bowels of blood-stained stools. In many instances, the patient, sinking from cachexia and exhaustion, is attacked by fatal pericarditis or pneumonia.

In open surfaces, whether from recent wounds or ulceration, the influence of the scorbutic taint is shown by swelling and lividity of the margins of the sore, and by a fungous condition of the granulations. The discharge becomes very fetid, and consists either of blood-stained serous fluid or of pure blood. There is a constant tendency to bleeding from such surfaces, and the dressings are speedily stained by the dark red discharge. Any incision, however small, into the soft parts is followed by persistent oozing of blood. In these scorbutic wounds and ulcers there is usually a tendency rather to spreading than to healing. Recent cicatrices readily break down, and are replaced by open sores with fungating and spongy granulations. The seat of a recent bruise or wound, or of an ulcer, is, in a scorbutic subject, generally surrounded by a very broad zone of intense ecchymosis.

It has been recorded that in scurvy the bones become fragile, and liable to fracture on the application of slight force, and that the fragments show but little, if any, tendency to unite. In some cases of previous fracture in which the fragments had joined, there was a tendency, it has been stated, for the callus to become absorbed. Such results, however, were probably due to an association with scurvy of one or more of the ordinary causes of general debility, and, in some instances, to the action of mercury, which was formerly so freely and indiscriminately administered on board ship.

The proper treatment of scurvy is, as a rule, most satisfactory in its results, as all the symptoms, both local and general, will readily disappear on the supply of a good mixed diet, including abundance of fresh succulent fruits and green vegetables, and lime or lemon juice in the form of lemonade. W. JOHNSON SMITH.

SEBACEOUS CYSTS are among the most common varieties of simple tumours. They may occur in any region of the body except on the palms of the hands and soles of the feet, where sebaceous glands are absent. These latter open, as a rule, into

the hair-follicles, but, occasionally, they discharge their secretion directly upon the surface of the skin. The cysts may be either congenital or acquired, and may vary from the size of a pea to that of a large orange. The acquired variety appears at any age after puberty, but most frequently in middle life. These cysts are essentially tumours of and in the skin, and are most frequently seen where the hair is abundant and the sebaceous glands are numerous, as on the scalp and face, about the entrance to the various passages of the body—the anus, lips, nose, and ears—and on the back of the neck, and over the scapulæ. The skin of other parts may be the seat of these tumours. The writer has removed one, the size of a walnut, due to obstruction of the mouth of a follicle, from the skin of the abdominal wall of a young girl. The axilla, though covered with hair and sebaceous glands, is remarkably exempt. The contents of a cyst consist of inspissated sebaceous matter, which has a peculiarly offensive odour. Under the microscope, cholesterine crystals are visible, and, in some cases of congenital scalp-cysts, fine hairs are found as well as epidermal matter. The cyst-wall may be either thin and delicate, or hard and thick, and strengthened within by many epidermal layers. The inner surface of the cyst-wall is smooth, rough, or reticular; and the contents are of no constant colour, and vary from their usual character, as above described, to the pearly tumour of Virchow or to a honey-like consistence.

Sir James Paget has divided the acquired variety of sebaceous cyst into two classes—those in which a black spot can be found upon the surface of the tumour, indicating the orifice of an obstructed follicle; and those in which no such orifice can be detected (as frequently happens on examination of a scalp-cyst), and in which the cyst probably owes its existence to some hereditary taint, and should be classed under the head of new-formations.

A dermoid cyst of the scalp is a congenital sebaceous cyst, and is often seen near the outer angle of the orbit. It frequently involves the wall of the cranium, is usually visible at birth or a few days later, but may be noticed first only at the end of the second or third month of life. When placed in or near the median line, the diagnosis from meningocele is sometimes almost impossible. See **MENINGOCELE**. On the scalp the acquired variety occurs, as elsewhere, most frequently in middle life, is not seldom multiple, and in rare instances, by gradual increase in size during many

years and the consequent gradual absorption by pressure of surrounding parts, involves the cranial vault. The tumour or tumours are hard or tense and fluctuating; round, oval, or, if large, irregular in shape, and movable. When a sebaceous cyst inflames and ulcerates, the diagnosis from epithelioma is not always easy; the proliferating surface and offensive secretion being so like the latter disease. *See SCALP, Injuries and Diseases of the.*

A fatty tumour can be distinguished from one of these cysts—(1) by the locality in which it is situated; (2) by its lobulated outline; (3) by the fact that it lies beneath the skin, which can be pinched up over the tumour, and thus thrown into characteristic wrinkles. Spontaneous changes are apt to supervene in these tumours, without even a history of slight injury. If inflammation comes on in this way, much care must be taken in the management of the case.

Horns not infrequently originate in accumulated sebaceous secretion, and have at their base a collapsed sebaceous cyst.

Of the rare forms of sebaceous cyst may be mentioned those situated completely within the skull, within the abdominal cavity or in the palate, mouth, tongue, testicle, submaxillary region or neck. Those found in the abdomen, which contain hair, teeth, bone, cartilage, &c., can hardly be looked upon as within the scope of this article, though their contents are largely made up of sebaceous matter. *See ABDOMINAL TUMOURS, Diagnosis of.*

The cysts which occur beneath the deep fascia of the neck are interesting from being easily explained as due to the incomplete coalescence of the branchial arches, or the incomplete obliteration of one of the clefts, usually that between the second (hyoid) and third (thyro-hyoid) arches. They form oval or elongated tumours, which are soft and putty-like to the touch, and whose contents are easily displaceable on manipulation. There is, as a rule, one-cyst, limited to either the right or left side of the neck, situated in the region of the hyoid bone, and which may or may not have been visible at birth. After its first appearance, it gradually increases in size to a certain point and then remains stationary. No pressure-symptoms are produced on the surrounding organs.

The deep submaxillary sebaceous cysts lie between the mandibular and hyoid arches, are placed laterally or in the mesial line, and are liable to be mistaken for ranula.

Treatment.—A sebaceous cyst can best be removed by dissection, or by transfixion and subsequent avulsion of the wall of the

sac. No part of the latter must be left, or troublesome after-consequences will ensue in the shape of continuous offensive discharge, an unclosed wound, and a permanent sinus. Operations upon these cysts should never be lightly undertaken, especially when there is more than one cyst or when the scalp is affected, and never except in persons in perfect health. If spontaneous inflammation occurs, an incision may be made into the cyst and other means be used to subdue the inflammation, but no attempt at removal is justifiable until all inflammatory action has disappeared. An ulcerated sebaceous cyst requires excision; so also does a horn of sebaceous material with a cyst at its base. The employment of caustics has been recommended (e.g. the liquor hydrargyri nitratis acidus), as it is said that erysipelas does not follow their use, and that patients are particularly susceptible to this disease after the more formal operation with the knife. Caustics are very tedious and painful in their action, and the surgeon had much better rely upon the means at his disposal for securing asepsis, than stake his reputation upon the prolonged application of an escharotic. In any doubtful case, the hair should be shaved for some distance around the tumour, the skin washed with soap, cleansed with ether, and every other device employed during and after the operation to keep the wound aseptic. The operation upon a congenital cyst of the scalp is more difficult than that upon the more common acquired variety, partly on account of its greater depth from the surface, and in part because of the thinness and delicacy of the cyst-wall and its adherence to the bone. It is to be remembered that a congenital cyst may completely perforate the skull and lie in contact with the duramater, so that great caution is necessary in deciding upon operative measures.

On the face these cysts are easily dealt with. The incision need not be long, or much disfigurement will result, and should be made in a direction depending upon the locality. The contents can then be squeezed out, the cyst-wall seized with forceps and dragged out forcibly, through even a very small opening. These face-cysts are most common in the skin of the side of the face, in front of the external ear.

The sebaceous cysts which lie beneath the deep cervical fascia can be divided, from the point of view of treatment, into two classes—(1) those which are very difficult to remove, since they run beneath the carotid sheath, and are often attached to the side of the pharynx and hyoid bone; (2) those

which do not present these difficulties during the operation of excision. In the former case, either the whole or the inner and deeper part of the branchial cleft is represented by the tumour. In the latter, we may suppose that the inner or deeper part of the cleft has been obliterated by the fusion of the branchial arches, whilst the outer part remains open through the cessation of the developmental processes, and subsequently becomes the *fons et origo* of a congenital sebaceous cyst, which is situated beneath the deep cervical fascia, and yet presents no great difficulties in removal.

Excision is the only treatment to be recommended for deep submaxillary sebaceous cysts. Any less radical measure, such as the use of a seton or setons, would almost certainly fail to obliterate the cyst, and would, if attempted, expose the life of the patient to considerable danger, on account of the facility and rapidity with which inflammation can spread to the larynx.

CHARLES A. BALLANCE.

SEBORRHŒA (*Synon.* Steatorrhœa; Dandriff).—*Definition.*—Seborrhœa is a disorder of the sebaceous glands, characterised by the deposit, on the surface of the skin, of oil or dried fatty matter.

Cause.—Frequently ill-health, chlorosis, exhausting diseases, phthisis, cancer, &c. In some cases the condition accompanies good health; occasionally it seems due to personal neglect.

Pathology.—A functional disturbance of the sebaceous glands, probably affecting both the quality and quantity of their secretion, which, instead of lubricating the surface in the normal way, is recognisable as an oily deposit or coating of dried fatty scales. It is commonest in situations where the skin is most abundantly supplied with glands—e.g. the scalp, face, nose, genitals. The deposit is found to consist of fatty matter and epidermal scales. The process may lead eventually to atrophy of the glands and hair-follicles.

Symptoms.—Two varieties are described, according to the nature of the deposit—(1) Seborrhœa oleosa, and (2) seborrhœa sicca.

Seborrhœa oleosa is rarely seen on any part but the face (nose, cheek, forehead), or bald scalp. The skin has a shiny, oily appearance, occasionally a dirty look from the admixture with the fatty deposit of carbon or dust of the atmosphere. The fat can be wiped off with a cloth, the surface is often reddish and cold, the orifices of the follicles being widely open or plugged with

comedones. This form of seborrhœa is rare, and is said to specially affect spirit-drinkers with fatty livers.

Seborrhœa Sicca.—The affection varies somewhat according to situation; hence are described—

(a) *Seborrhœa Capitis.*—This is by far the most common form: the sebaceous secretion dries on the surface of the scalp into thin, white, branny scales, known popularly as *dandriff*. These scales are constantly being removed by brushing, and fall about the shoulders; or they are thicker and yellowish in colour, caked upon the scalp or matting down the hair. Seborrhœa capitis generally affects the entire scalp, but it occasionally occurs in patches. On raising the scales, the skin beneath is seen to be of a characteristic leaden grey colour; more rarely it is of a pinkish or red colour, from the presence of some amount of inflammation. These latter cases are sometimes accompanied by burning or itching, with epidermal desquamation, and are probably more allied to eczema.

If the affection has been present for some time, there is more or less thinning of the hair, which may go on to permanent alopecia in consequence of the destruction and atrophy of the hair-follicles.

In infants, the scalp is frequently the seat of seborrhœa, which may be considered as a persistence of the physiological seborrhœa (*vernix caseosa*) of the newly born.

(b) *Seborrhœa Faciei.*—The forehead, nose, and cheeks are the parts usually attacked. These present a mask-like covering of greasy scales, in colour varying from a pale yellow to a dark olive-green, according to the complexion of the individual and the admixture of dirt. On peeling off the scales, little processes or plugs are seen on their under surfaces, corresponding to the orifices of the follicles. Some itching and hyperæmia may be present.

(c) *Seborrhœa Genitalium.*—The glands in this situation frequently present the seborrhœic condition. A white, soft, cheesy deposit is seen, in the male, on the glans penis and sulcus, in the female about the labia and clitoris; its decomposition may lead to irritation, resulting in balanitis in the male. In young females, the resulting inflammation may be of medico-legal interest.

(d) *Seborrhœa Corporis.*—Dühring describes, under this name, a variety of seborrhœa affecting the back between the shoulders, or the sternal and clavicular regions. It occurs in circular patches with pale reddish base, and grey or yellowish

scales; the patches frequently run together, and the appearance may closely simulate *tinea circinata*. The affection known in this country as *lichen marginatus* or *circinatus* is comparable.

Diagnosis from *eczema*, *psoriasis*, *lupus erythematosus*, *tinea*. On the face or scalp, *seborrhœa* may simulate *eczema*; the trivial itching, the absence of serous exudation and infiltration, in *seborrhœa*, are in marked contrast to the symptoms of *eczema*. In typical *seborrhœa capitis*, the pale anæmic scalp is quite different to the red scalp of *eczema*. On the scalp *seborrhœa* may simulate *psoriasis*, but the evenly spread greasy scales, with the pale skin beneath, are unlike the uneven, mortar-like scales of *psoriasis*, with its constantly accompanying inflamed condition of the skin beneath. In *seborrhœa faciei* the processes on the surfaces of the scales are very characteristic.

The name first suggested for *lupus erythematosus*—viz. *seborrhœa congestiva*—indicates the similarity which may exist between their objective symptoms. Reliance should be placed on the deeper redness or violaceous tint of *lupus*, its defined limit or line of demarcation, its infiltration and constant scarring, its tendency to affect the helix of the ears and to occur in subjects liable to chilblains.

Treatment.—When indicated, the hygienic surroundings should be improved; fresh air and moderate exercise should be ordered, especially in chlorotic females. Cod-liver oil and iron will be found the most useful internal remedies; the latter may be advantageously combined with arsenic. Calcium sulphide is recommended in doses, gr. $\frac{1}{10}$ — $\frac{1}{5}$, thrice daily.

Local treatment is most important, especially for *seborrhœa capitis*. Scales must first be removed; this is best done by thoroughly saturating the scalp with olive oil at night-time, a closely fitting flannel cap being worn for the night. In the morning, the head should be washed with solution of equal parts of soft soap and alcohol. This is rubbed over the scalp and a lather produced with flannel and hot water. After all soap is removed and the hair is dried, a little almond oil may be applied. Care should be taken to warn the patient that the washing will remove all loose hair. The washings should be repeated, as directed above, every two days until all scales are removed; longer intervals may be allowed if there is much irritation produced by the soft soap.

The after-treatment consists in the use of a stimulant application—e.g. *R. Acidi car-*

bolici liq. f3ss.; *Ol. amygdalæ dulc. f3ss.*; *Alcoholis f3v.*; *Ol. bergamot q.s.* To be sponged on the surface of the scalp night and morning; or the following pomade may be rubbed on the scalp with the fingers:—*R. Pulv. hyd. oxid. rub. gr. v.*; *Adipis præp. 3j.*; *Ol. bergamot q.s.* It is not necessary to cut the hair.

The above treatment is applicable also to *seborrhœa* occurring on the non-hairy parts.

For *seborrhœa* of the genitals, washing with ordinary soap, combined with the after-application of an astringent alum wash, is sufficient. ALFRED SANGSTER.

SENILE GANGRENE. See GANGRENE.

SEPARATION OF EPIPHYSES.—

The traumatic forms only will be considered in this place: those arising from constitutional causes, or from disease in adjoining parts, having been dealt with under EPIPHYSES, Affections of.

It is manifest that this accident can only befall individuals in whom the epiphyses have not become joined to the shafts by bony union—that is to say, it can only occur up to about twenty-one years of age; in the majority of cases the patients are much younger. In one case, however, recorded by Bruns, the accident happened to a man in his twenty-fifth year. Apart from the cases occurring during childbirth, of which many instances are recorded by French authorities, undoubted cases occur in quite early childhood. Hamilton mentions a case at the shoulder-joint at thirteen months of age; Holmes one of the femur (lower) at eighteen months. It might be supposed that young children would be most liable to this form of injury; but statistics negative this conclusion, and show that it is most frequent between twelve and seventeen years of age. It seems reasonable to explain the immunity of younger children, by supposing that they are less exposed to the kind of accident which brings about this special form of injury. Owing to the difficulties of diagnosis, it is not improbable that many cases go unrecognised. The separations may be either simple or compound, single or multiple, partial or complete, and accompanied or not by other injuries, which may require independent treatment.

Causes.—Epiphysial separation may result from violence applied directly to the seat of injury, such as the passage of a cart-wheel over a limb near a joint; or from a

fall from a height, as from an upper storey window or into a ship's hold; or from the entanglement of a limb, in the spokes of a waggon-wheel or in moving machinery, exercising traction upon the joints; or from muscular violence, and occasionally from suddenly raising a child by its limbs. The injury has also been produced by traction on the limbs during childbirth. The most frequent cause is a fall from a height, and then, not seldom, several epiphyses may be implicated as well as other injuries inflicted. Thus, Mr. Hutchinson records the case of a sailor boy aged fourteen, who fell from the masthead, and sustained a fracture of his clavicle, and separation of the lower epiphysis of one humerus and of both epiphyses of the other. Mr. Holmes records a case of separation of the lower epiphysis of the femur and of the tibia, and probably also of both epiphyses of the fibula. The case is on record of a girl who pushed her toes under a door; in trying to withdraw them she separated the epiphysis from the shaft of the first phalanx of the great-toe. A boy, aged nine years, when playing at leap-frog, fell, his hand coming violently on the ground, and separated the lower epiphysis of the radius. Mr. Heath reported to the Clinical Society the case of a boy, aged fourteen, who, whilst raising his arm violently to bowl at cricket, felt something give way at his collar-bone. It was found that the epiphysis of the clavicle had become separated. The experimental production of this condition is most easily accomplished, at the ginglymoid joints, by an excess either of extension or of lateral movement; at the enarthrodial joints by an excess of abduction (Gurlt). Traumatic separation of the lower femoral epiphyses has been advocated in, and practised for, genu valgum. Although many cases have been treated in this manner, but very little subsequent interference with the growth of the limbs appears to have occurred, notwithstanding that separation of other epiphyses had been unintentionally produced at the same time.

Pathological Anatomy.—The points of chief pathological interest are—(1) does the injury occur exactly at the epiphysial line or does it involve some part of the shaft also? and (2) what are the effects of such an injury on the future growth of the bone? As regards the first point, there can now be no doubt that the separation may and does occur without any implication of the shaft: for such cases have been seen by competent authorities. In some of the compound cases, the extremity of the shaft has been found projecting from the wound, and has thus

placed this question beyond all dispute. What occurs in the case of a compound injury may also occur in a simple one. Nevertheless, the line of separation seldom runs accurately across the line of junction; the displaced epiphysis carries with it some portion of the diaphysis. 'The importance of the question,' says Mr. Holmes, 'about the precise position of the line of fracture is this: if the fracture be really a laceration of the epiphysial cartilage, this structure may be expected to be more or less altered by the inflammatory processes necessary for the cure of the injury. The ossifying tissue may consequently be permanently damaged, and loss of growth may result; on the other hand, if the injury be confined to the diaphysis, no such consequence seems likely to follow.' In some cases a considerable wedge of the diaphysis, together with its periosteum, may be included. The exact condition, as well as the subsequent course of events, is probably influenced by the age of the patient.

If the accident occurs in an adolescent, in whom growth and ossification are nearly completed, there is every probability that some portion of the diaphysis will be torn away; on the other hand, secondary consequences will be less marked; whereas, in a child, the greater amount of soft new bone along the line of junction and the greater general elasticity of the diaphysis render detachment of the epiphysis more easy, and fracture of the shaft less probable. *Per contra*, the repair of such an injury, even under favourable circumstances, must for a while, if not perhaps permanently, interfere with the growth of the bone. The extent of this interference will depend in some measure on the nature of the accident and on the amount of local injury; and when any arrested growth does follow, its effects will always be marked in proportion to the extent to which the bones have still to grow. The relative part played by the different epiphyses must, of course, be borne in mind in estimating the probable loss of growth, which may ensue in any given case: thus the humerus grows chiefly from its upper (in the proportion of two to one), the femur from its lower, epiphysis; and so, too, with the other long bones.

Separation of the epiphyses is by no means uncommon in early infancy, as the result of disease. The absolute integrity which may be re-established sufficiently shows that arrested growth is by no means a necessary sequel of separation, and it can hardly be doubted that many traumatic cases recover without ill-effects. It would

seem, therefore, that the results depend a little on whether, after accident, the parts can be put in thorough apposition. Probably, this depends on whether any and what portion of the shaft is displaced, together with the epiphysis, and to what extent the periosteum has been stripped up. Stripping up of the periosteum, to an extent not usually found in fractures, is quite a pathological feature of separation of the epiphysis, and is explainable by the greater thickness and vascularity of the periosteum, and by the intimate connection between epiphysis and periosteum which normally exists, and especially at the period of life when this form of accident is common. There is naturally great danger of synovitis, purulent or otherwise, with all the sequelæ which such a complication entails. From this cause suppuration not infrequently occurs, necrosis of either shaft or epiphysis being sometimes the result. Among the secondary pathological features, must also be mentioned atrophy of muscles and loss of power in the affected limb consequent on disuse. Mr. Bryant has recorded a case of separation of the lower extremity of the humerus, in which the displaced anterior border of the diaphysis so injured the brachial artery as to occlude it—recovery, however, taking place.

Symptoms and Diagnosis.—(General). The diagnosis of these injuries is often extremely difficult, and rests on a combination of symptoms rather than on any special one. A separation may reasonably be suspected when an injury, in a young person, partakes of the nature both of a dislocation and of a fracture. The crepitus in a separation of epiphysis is not always distinct as in fracture (it may be entirely absent); on the other hand, there is often unusual mobility for a dislocation. Unlike a dislocation, reduction is not accomplished suddenly and with the jerk peculiar to this injury, nor does the patient get the same comfort as after the reduction of an ordinary dislocation; moreover, the displacement recurs much more frequently and readily, where there is separation of the epiphysis than after a true dislocation has been reduced, and it is often a matter of difficulty to maintain the bones in coaptation. The amount and direction of the displacement, in any given case, will vary with those of the applied violence. In all cases of doubt, the symptoms should be contrasted with those usually found in a fracture near, and in dislocation of, the joint in question, and the correct diagnosis be arrived at by the method of exclusion. In

many cases of direct injury in the neighbourhood of joints, with open wounds, separations of the epiphysis may be found; the nature of such cases will, however, be obvious. Not improbably, the other injuries will absorb attention and control the treatment; the chief difficulties will be experienced in uncomplicated cases, the symptoms of which will naturally vary with the joint affected. Theoretically, the epiphyses of any of the long bones may be separated by injury; in actual practice, however, some bones are found to suffer more frequently than others. In 100 collected cases, Bruns gives the following ratios:—Humerus—upper epiphysis, 11, lower, 4; ulna—upper epiphysis, 1, lower, 2; radius—lower epiphysis, 25; femur—upper epiphysis, 2, lower, 28; tibia—upper epiphysis, 4, lower, 11; fibula—upper epiphysis, 3, lower, 4; metatarsus, 2; pelvis, 3.

Shoulder-joint (upper epiphysis of the humerus).—Generally there is swelling of the joint, which must almost necessarily be opened, but the amount will depend on the nature and severity of the injury. In all the recorded cases, the shaft of the humerus has been displaced forwards and upwards (the pectoral muscles assist in this) towards the coracoid process, where it can be seen and felt; it is, nevertheless, conceivable that violence applied to the front of the joint would displace the shaft in an opposite direction. The extremity of the bone is smaller and not so smooth as the normal head, nor so sharp and angular as in fracture. The head of the bone can be felt in the glenoid cavity; it can be made to move independently of the shaft, as the shaft can be rotated independently of the head. On making traction at the elbow, with the thumb pushing the shaft back to its normal position, crepitus will sometimes be felt; there is usually no difficulty in placing the elbow in contact with the side, differing in this respect from a dislocation. If the separation is complete there will be shortening, as in fracture of the surgical neck. The axis of the limb is directed downwards, outwards, and backwards; over and above this injury there may, of course, be others.

Elbow-joint (lower epiphysis of humerus).—Here, again, the symptoms and diagnosis may be complicated or not with swelling or external wound. The usual displacement is backwards. Given, an elbow-joint in a young subject having the appearance after an accident of a dislocation backwards, the triceps muscle arched, with

the sharp prominent extremity of the shaft of the humerus visible or tangible in front of the joint, separation of the epiphysis would be a justifiable diagnosis; if the bony prominences (the condyles of the humerus above, and the head of radius and the olecranon below) could be distinctly made out, their proper relative positions in an otherwise obscure case would be strongly confirmatory of this diagnosis. A dislocation after reduction would show less tendency to relapse than a separation, and its mode of reduction would be different: the elbow is flexed.

Wrist (lower epiphysis of the radius).—Mr. Holmes says that this injury 'differs from Colles' fracture in its symptoms, inasmuch as it does not present that obliquity of the hand which is a marked feature in many cases of the other injury.' R. W. Smith gives a further means of distinguishing it by saying that the projection on the palmar aspect of the forearm is more marked than that on the dorsal, and that the sulcus which limits the dorsal tumour is horizontal instead of being oblique. In this, as in most other cases, the relative positions of bony prominences are of importance; in a dislocation of the hand, the styloid process assumes an abnormal position, but in separation from the shaft, the radial epiphysis follows the hand, and maintains its normal relative position. Cases are recorded in which the epiphysis of the ulna is displaced also; in other cases there has been fracture, low down, of the shaft of the ulna.

Hip-joint (upper epiphysis of the femur). The symptoms of this exceedingly rare injury can 'in no respect be distinguished from the fracture within the capsule' (Chelius); the latter, however, occurs almost solely in elderly persons. South records a case in a boy ten years of age, who fell out of a window on to his left hip. 'The foot was slightly turned out, and scarcely any difference in the length of the two limbs could be observed; the hip could be readily moved in any direction without much pain, but, on bending the knee and rotating the limb outwards, a very distinct *dummy sensation* was felt;' he made a good recovery. In another case, there was crepitus, eversion of the foot, and shortening to the extent of one inch (Post). The writer has seen a case which simulated hip-joint disease. De Morgan related the case of a young man age nineteen; while standing on some movable steps, they slipped from under him, and he was thrown four feet on to the flags below, striking the back of his hip with

great violence against the edge of some railings. The symptoms were eversion of foot, the outer surface of the trochanter looked backwards, there was one and a half inch real shortening (which was readily reduced, and as easily recurred). The trochanter, less prominent than on the opposite side, rotated with the shaft; there was obscure crepitus. He recovered with bony union.

Knee-joint (lower epiphysis of femur).—Separation of this epiphysis is much more common than the preceding one. It may occur laterally. Bryant records a displacement inwards, but the most common displacement is forwards. Speaking of this injury, Bryant says: 'A displacement of the lower epiphysis of the femur may be mistaken for dislocation of the knee, and in young subjects, where this latter accident is supposed to have taken place, the surgeon should always consider the probability of the injury being of the former kind.' Charles Bell records two cases. One was followed by suppuration in the knee-joint, with secondary perforation of soft parts by the femoral diaphysis; the other (caused by the limb becoming entangled in the spokes of a wheel) had to undergo amputation four years later on account of an aneurism caused by the displaced diaphysis. The knee-joint may escape being opened, as in a case recorded by Hawkins.

(Upper epiphysis of tibia).—In a case of double genu valgum, in which Delore had purposely detached the lower epiphyses of the femurs, the patient (a boy, aged seven) dying of measles on the twenty-first day, the epiphyses of the right tibia and of the left fibula were found ruptured. Traumatic cases are recorded with multiple injuries, where amputation has had to be practised in consequence of necrosis and of suppuration in the knee-joint (and ankle-joint also—Fischer).

Ankle-joint (lower epiphysis of tibia). These generally result from a high fall on to the soles of the feet, the momentum carrying the body forwards, so that the epiphyses and the feet are displaced backwards. Such cases will resemble a dislocation of the foot, from which it will be differentiated by the relative positions of the malleoli and feet remaining normal; the sharp edge of the lower extremity of the tibia will be perceptible in front.

As quite exceptional cases, may be mentioned—the 'epiphysial ends of the pubes and ischium separated in the hip-joint in a case of fracture of the pelvis' (Holmes); separation of the epiphysis of the great

trochanter of the femur (Key ; McCarthy) ; separation of the epiphysis of the two anterior iliac spines, along with that of the head of the femur (Bousseau) ; separation of anterior superior iliac spine from muscular action (Maunder) ; separation (with suppuration) of the epiphysis of the tuber ischii following a kick (the writer) ; separation of the symphysis pubis, from being run over (Holmes) ; separation of the epiphysis of the first phalanx of the great toe—'the head of the metatarsal bone could be felt intact, with a rounded movable piece adherent to it, upon which the toe appeared to play' (Gascogen).

Treatment.—It has been pointed out that cases of this injury vary very much among themselves, and thus no hard and fast line of treatment can be laid down. In cases of simple injury, the first care, and often the most difficult problem to solve, is to reduce the displacement and apply such a splint or bandage as will maintain the limb in its normal position. Plaster of Paris will be found very effectual ; it must be put on carefully, with a good layer of wadding next the skin—not too tight, yet firm enough to prevent re-displacement (by muscular action or the patient's movements)—and the whole limb must be kept at rest. If there be much heat and swelling, an ice-bag may be placed over the joint, and a gutta-percha or felt splint temporarily applied ; when these subside, the plaster bandage may then be put on. In compound cases plaster is seldom available, and even in many cases of simple displacement it may be more advantageous to use other forms of splinting.

Reduction of the displacement may be effected with or without anæsthetics. Like all injuries about joints, these cases should be examined from time to time, and passive movements commenced in order to guard against ankylosis. If gently applied, these movements may be commenced at the end of a week, according to circumstances and the joint affected. It is quite evident that, if any adhesions are about to form in a joint, they will be broken down at the end of a week with less pain and more readily than at the end of two weeks or longer. No hard-and-fast line of treatment can be laid down either for compound injuries or for cases of multiple injury. In some of the recorded cases, the extremity of the diaphysis has projected through the soft parts, and has had to be sawn off in order to effect reduction ; in other cases, gangrene has resulted from pressure of the displaced diaphysis on the vessels, and amputation has had to be resorted to. In some cases, owing

to injury of the periosteum and surrounding parts, suppuration has occurred, with exfoliation of the necrosed epiphysis. The adjoining joint is sometimes destroyed, and amputation becomes necessary.

Quite recently, Bruns of Tübingen has introduced and successfully carried out a new operation in two cases of old separation of the upper epiphysis of the humerus, 'which had not been recognised in the fresh condition, and which had healed with so much displacement that the utility of the arm was greatly impaired.' He deliberately cut down on the epiphyses, effected a separation of the adherent fragments with a small saw, removed a portion of the diaphysis, and then placed the fragments in their proper relative positions. Both operations were successful. Sublimate wool was the dressing used. Bruns also recommends this operation, with or without resection of the diaphysis, in recent cases of irreducible separation. It seems not unfair to anticipate that many cases which, formerly, would have been amputated, may in these days of antiseptic surgery be preserved ; and it is also probable that those surgeons who practise rigid antiseptics, will feel themselves justified in cutting down upon detached epiphyses and wiring them to the diaphyses, when other means have failed to keep the bones in juxtaposition.

Prognosis.—This will vary with the exact nature of the injury in different cases, and with the age of the patient. In young children, apart from other possible results, must always be borne in mind the probable impairment of growth in the length of the affected limb, whenever the affected epiphysis is much concerned with this growth. It is not possible to assert positively whether this impairment will occur ; the less the amount of local injury, the more complete the reduction and coaptation of the fragment, the less probable will this complication become, while opposite conditions will favour its occurrence. Nevertheless, so far as can be gathered from the hitherto published cases, this arrested growth occurs but seldom. It is true that the cases of arrested growth may not come under observation ; but, on the other hand, the original injury would certainly do so, and yet the total number of cases is relatively small when considered beside other forms of fracture. The next point to be considered is the effect on the joint itself. In some cases, ankylosis results even in simple injuries, while in compound injuries, purulent synovitis and periostitis

of the shaft may so complicate the accident that the patient's life is only saved at the expense of the limb. Reference to gangrene has already been made. The adoption of Bruns' method in cases of irreducible displacement will probably save many a limb alike from atrophy, from gangrene, and from amputation.

ROBERT WILLIAM PARKER.

SEPSIN was the name first given by Bergmann to an alkaloidal substance which he, with Schmiedeberg, succeeded in isolating from putrid yeast. This substance was obtained as yellowish acicular crystals of a sulphate salt (sulphate of sepsin); it gave all the reactions of an alkaloid like strychnia, &c., and when injected into the circulation in dogs produced the symptoms of **SAPRÆMIA**—i.e. rigors, fever, vomiting, restlessness, diarrhoea (often bloody), coma, and death; the post-mortem signs being, as a rule, multiple punctiform hæmorrhages, swelling of the spleen, and cedema of the lungs. Since the publication of this result, numerous observers have obtained similar poisonous alkaloidal substances from various putrid albuminous fluids and substances—e.g. maceration fluids, putrid pus, 'high' game, rotten cheese, hams, sausages, &c. The alkaloidal bodies of the same class, but which are obtained from corpses, have received the name of ptomaines, and this term is sometimes employed, with great advantage, to denote the whole number of putrefactive alkaloids. The claim of all these substances to be regarded as alkaloids rests on the double evidence of chemical test and physiological action.

As to their *chemical reactions*: they are separable from alkaline solutions; they combine like weak bases with the mineral acids; they give a yellow flocculent precipitate with phosphomolybdic acid; with iodine they give a brownish precipitate; with gold and platinic chloride they give respectively a yellow and orange precipitate; they are also thrown down as whitish precipitates by tannin and corrosive sublimate; while, to conclude, they are very frequently crystalline. Fused on platinum, they char and give off peculiar odours.

The ptomaines (using the word for all kinds of putrefactive alkaloids) obtained by Schmiedeberg, Brieger, and others from various putrid substances, meat, fish, &c., by a modification of the Stas-Otto process for extracting alkaloids, may be enumerated as follows:—

(1) Those possessing physiologically active properties—

Cholin.—A derivative of lecithin. Hence found in 'bad' eggs. If oxidised, produces muscarin.

Muscarin, a very powerful poison found in putrid fish, and known for a long time as the poison of fungi.

Mydalein, most important as causing *pyrexia* in addition to the general symptoms of ptomainic poisoning about to be described.

A body resembling *atropin*, producing symptoms closely similar to atropin poisoning, including ophthalmoplegia externa. Found in putrid meat of various kinds.

Sepsin, already mentioned above.

Neurin, a powerful poison, found in putrid fish.

Ethylenediamine, a similar poison, one of the compound ammonias like trimethylamine, prepared from putrid fish.

A body similar to digitalin in its effects, and two others which cause profuse diarrhoea have been extracted from decomposing corpses.

(2) Those which do not exhibit active physiological properties—

These possess very little interest for the practical surgeon, and therefore it need only be mentioned that a series of inert bodies closely allied to those not described have been found in putrid liquids, and have been named by Brieger, neuridin, cadaverin, saprin, putrescin, gadinin, &c.

Clinical Import.—Poisonous alkaloids, of the kinds just described, have been discovered by Bocci and Bouchard to exist in normal urine and fæces, both in the lower animals and in man. The latter writer has made the reasonable assumption, that these bodies are constantly being formed in the process of digestion and as constantly excreted by the kidneys. Unfortunately, putrid discharges from surgical wounds have not as yet been examined for ptomaines, but of course similar bodies must be found, which by absorption may produce the symptoms of **SAPRÆMIA**, the so-called septic intoxication or poisoning.

Again, the fact of the existence of these substances is of extreme practical importance, in considering the symptoms of acute intestinal obstruction and other conditions in which retention of fæcal matter occurs. In these cases the symptoms—vomiting, salivation, headache, frequency and irregularity of the pulse, generally attributed to reflex irritation of the medulla oblongata through the vagus—may be due to direct poisoning of the same from absorption, by the bowel, of the alkaloidal bodies formed

during digestion. Confirmation of this view may be found in the fact that washing out the stomach considerably relieves the urgency of the symptoms. In connection with this point, it must be remembered that the alkaloidal ptomaines, just described, differ considerably in some points of pathological action. These points we will now briefly consider, as they thus come to have a practical bearing.

Pathological Action.—When absorbed into the blood, the most universal symptom and one common almost to all the substances mentioned above, is diarrhoea, usually due to excessive peristalsis and secretion of mucus, with active congestion of the mucous membrane of the bowel, leading sometimes to extravasation of blood. On the other hand, there is sometimes paralysis of the muscular wall of the gut, accompanied by a 'paralytic' secretion of intestinal fluid. Next to diarrhoea (or purging), vomiting, heralded by a rigor, is a very common symptom, the very frequent association of these two conditions leading one to suppose that they are the result of the action of the poison on the medulla oblongata. At the same time, the vaso-motor centre is irritated so as to lead to general vaso-motor spasm, or at any rate contraction of the arterioles, this being particularly the effect of muscarin and its allies, while vaso-motor dilatation (if not paralysis) is as equally characteristic of atropin, &c. The evidence obtained from the pupil is usually looked on as most important, and, as an index to suggest that the ingestion of a poison has occurred, it is doubtless useful. Most are like atropin—viz. mydriatic—i.e. they dilate the pupil. A few, however, cause contraction of the same. Other directions in which these poisons act are by way of excessive secretion, salivary, &c., like mydalin, or, on the other hand, like atropin they produce a total arrest of such secretion, so that the mouth becomes perfectly dry.

If the ptomaine is taken directly into the stomach, as happens sometimes in taking tinned meats, game pies, &c., the effects are very rapid and violent; the symptoms simulating those of acute irritant poisoning—viz. vomiting and purging, collapse, coma, and even death in four or five hours. The effects are, of course, exactly proportional to the dose absorbed.

Treatment.—This article is merely descriptive of the sepsin compounds. For the symptoms and treatment, &c., of cases poisoned with the same, see SAPRÆMIA.

VICTOR HORSLEY.

SEPTIC DISEASES, Classification and Etiology of.—It is a hazardous thing, at any time, to attempt to classify and arrange even diseases the pathology of which is fairly well ascertained, and still more dangerous, therefore, to propose any arrangement for such an obscure and complex series of maladies as those which are termed 'septic.' Some writers have endeavoured to avoid the difficulty by assuming the wide differences between one case and another to be a question of degree only, and not of kind; but, fortunately, experimental pathology has come forward and rescued surgical science from the error of regarding the septic diseases as merely phases of the same process, and from concealment of want of knowledge under the plausible verbiage of unification. In fact, the pathology of these diseases is now (theoretically) so clear, that we may say it will be soon much more difficult to find a case of septic disease than to refer it to this or that class, since the prophylaxis of antiseptic surgery is gradually stamping out every variety.

The term 'septic disease' is generally understood to include every disease which can be shown to arise from putrefaction or fermentation. Although it would be more strictly accurate to make it embrace all cases of acute specific disease, the popular acceptance of the term does not include the acute exanthemata, such as typhoid fever, &c., these being unscientifically regarded as a separate family with the appellation of 'zymotic.' In passing, it is fitting to say here that a contracted expression, 'sepsis,' is gradually being adopted, especially abroad, to signify much the same thing as our term 'septic disease,' especially since it is usually employed to denote the fact of the likelihood that a patient, the subject of an operation, &c., may be attacked by the same. But, to return, the term 'septic disease' includes the following *general and local diseases*:—

1. Sapræmia.
2. Septicæmia.
3. Pyæmia—

} central,	or	} embolic,
} peripheral,		} exanthematous.
4. Puerperal Fever.
5. Erysipelas.
6. Infective Cellulitis, including Poisoned Wounds.
7. Acute Spreading Traumatic Gangrene, including 'Quarter Evil,' 'Cancrum Oris,' &c.
8. Hospital Gangrene.
9. Malignant Pustule.

10. Acute Necrosis or Infectious Osteomyelitis.

11. Farcy or Glanders.

This heterogeneous list, which includes affections purely local and others absolutely general, will suffice to show how hopelessly inadequate any theory must be which regards such diverse effects as being due to one and the same cause only.

It becomes necessary now, in describing these diseases, to separate them on some sound basis. Such a basis can only be founded on an accurate conception of the pathology of each disease. Whatever the nature of the septic virus in any one of the above-mentioned maladies, it is clinically obvious that it acts either by rapidly and directly affecting the whole system, or else, indirectly, by causing local mischief from whence poisonous products are absorbed into the general circulation.

It is therefore most convenient, and scientific withal, to divide the septic diseases into two main clinical divisions—(A) *General* and (B) *Local*; this separation meaning that, in the first class, the whole system is primarily infected, and that local mischief follows; while in the second class local mischief is the first thing, and general systemic poisoning a consequence.

DIVISION A. — GENERAL DISEASES.—

1. *Sapræmia*—i.e. poisoning by an alkaloidal product (purely chemical and non-vital) of decomposition. See SAPRÆMIA; SEPSIN.

2. *Septicæmia*—i.e. general infection of the whole system by a rapidly-increasing poison, which is usually inoculated in very small quantities, such poison being probably a parasitic micro-organism. In this variety of septic infection there is no formation of secondary abscesses. See SEPTICÆMIA.

3. *Pyæmia* (including Umbilical Pyæmia of new-born infants, Farcy, &c.)—i.e. general infection of the whole system by a slowly-increasing poison, which is sometimes inoculated in very small quantities—probably, therefore, a parasitic micro-organism—and which always produces secondary abscesses. See PYÆMIA.

Pyæmia, as it is seen clinically, is divisible into two classes, which, for want of better terms, may be called 'peripheral' and 'central,' such expressions referring solely to the position of the secondary abscesses. The pathology of these two classes is also different; this, of course, accounting for the difference in position of the lesions. Thus, in the 'central' variety the primary wound is usually a large, septic, inflammatory focus, situated in the neigh-

bourhood of veins of considerable magnitude. As a necessary consequence, septic thrombosis in the veins occurs. The septic clot thus formed is greyish and friable; portions become detached, conveyed to the right side of the heart, hence to the lungs, and so to the systemic circulation through the left side of the heart. Weber showed, long ago, that poisonous emboli could find their way through the pulmonary capillaries and lodge in any part of the general systemic circulation—e.g. spleen, liver, kidneys, &c.; but the assumption that the so-called 'pyæmic infarct' is not a true infarct, as produced by inert emboli, but rather a centre of septic necrosis, is probably the more accurate view of these 'central' lesions; so that their causation is to be attributed to the immediate action of the pyæmic virus, and not to a primary embolism followed by secondary septic inflammatory mischief. Whatever we may regard as the mechanism at work in causing abscesses in the internal organs, the distinction between the two clinical varieties of pyæmia just described must be borne in mind—viz. that there is one kind in which the lesions (abscesses, &c.) are mainly central, and another in which they are peripheral—i.e. confined to the joints, bursæ, fasciæ, &c.

4. *Puerperal Fever*—a vague term which is commonly employed to denote that a patient, who has just been confined, is suffering from either sapræmia, septicæmia, or pyæmia. No further reference in detail will be made in this article to puerperal fever (as it is generally understood), since the condition of a puerperal woman is precisely that of any other kind of surgical liability to infection with one or other of the three septic diseases just mentioned, as a natural consequence where ordinary prophylactic antiseptic precautions have been neglected.

DIVISION B. — LOCAL DISEASES.—

5. *Erysipelas* is an acute specific disease, affecting secondarily the whole system, which follows the (primary) inoculation of a wound by a parasitic pathogenic micro-organism (*Micrococcus erysipelatosus*).

This definition applies solely to 'surgical erysipelas,' so called—i.e. the erysipelas which attacks an open wound—and in no way refers to so-called 'medical,' 'idiopathic,' 'facial' erysipelas, the pathology of which has not yet been completely investigated. The incubation-period of traumatic erysipelas is about twenty-four hours. The organism grows through the lymph-channels of the subcutaneous tissues, producing characteristic local and general

symptoms, for the description of which see Erysipelas.

6. *Infective Cellulitis* (including Poisoned Wounds) is a purely local affection consisting in a spreading inflammation, possibly due to a parasitic micro-organism or, indirectly, to the poisonous action of some product of decomposition. The patient is, in addition, secondarily poisoned by the absorption of the inflammatory products. See CELLULITIS; POISONED WOUNDS.

7. *Acute Spreading Traumatic Gangrene, including Quarter Evil*, is an acute, specific, inflammatory process, terminating invariably in gangrene. It is due to the inoculation into the tissues (frequently already injured by traumatism), usually subcutaneously, of a specific poison, which has been proved to be a thick bacillus in the case of 'quarter evil;' and since a similar organism has been found in cases of acute spreading traumatic gangrene in man, it is possible that it (the virus) is always the same bacillus.

The disease known in cattle as 'quarter evil,' the 'charbon symptomatique' of French writers, and the Rauschbrand of the Germans, occurs rarely in England, but has been transmitted (by direct inoculation) to man. It consists in a spreading inflammatory area, the centre of which is gangrenous. The patient thus absorbs the poisonous products of the tissue-necrosis.

Acute traumatic gangrene is the 'gangrène foudroyante' of the French authors. The condition known as noma or cancrum oris is properly included in this class.

8. *Hospital Gangrene* is a rare local affection, consisting primarily in an inoculation of a wound by a poison generated in an ahygienic hospital, and which is probably a parasitic micro-organism (a micrococcus), with a primary effect of causing a steadily progressive necrosis of the wound surface, and a secondary effect in producing general septic poisoning of the system. For details of this affection, see HOSPITAL GANGRENE; but it must be here noted that allied to this condition (in which the wound becomes covered with a tenacious, adherent, grey and fibrinous slough) are those cases where a wound is covered with a diphtheritic pellicle; and, indeed, cases of sloughing membranous pharyngitis ought to be included under the same heading as cases of hospital gangrene. In every variety of the affection there is, of course, secondary general septic poisoning.

9. *Malignant Pustule*.—An acute specific disease due to the growth of a parasitic pathogenic micro-organism (*bacillus an-*

thraxis). When inoculated locally, it produces a carbuncle of peculiar character. When inhaled, it produces a general poisoning of the system known as 'charbon,' or 'wool-sorters' disease.' See MALIGNANT PUSTULE.

10. *Acute Necrosis or Infectious Osteomyelitis*.—An acute specific disease in which the periosteum and marrow of any bone (usually a long bone) becomes the seat of acute suppurative inflammation very soon after some injury (frequently trifling); such local inflammation being followed by the lighting up of 'central' pyæmic lesions in the lungs, heart, &c. The poison is probably a micrococcus.

11. *Farcy or Glanders*.—A variety of Pyæmia. GLANDERS is so regarded as a special septic disease that it is mentioned separately here, but it more properly falls under the heading PYÆMIA.

Before discussing the etiology of the diseases just mentioned, reference must be made here to a certain causal nexus which exists between some of the exanthemata and the condition of patients after surgical operations, &c. Setting aside cases of so-called rheumatism occurring after gonorrhœa, and which are nothing more than subacute pyæmia, we must briefly notice the following facts:—

1. That scarlet fever is particularly liable to attack children recently operated upon, especially in cases where an operation has been performed for stone in the bladder or cleft palate.

2. That scarlet fever is particularly liable to attack the puerperal woman.

3. That although scarlet fever and erysipelas do not infrequently attack a puerperal woman and run their specific course, yet occasionally it would seem that, although the poison of one of these diseases has certainly been inoculated into a puerperal patient, it has not developed in the specific manner, but as a variety of 'puerperal fever.'

1. The scarlet fever which thus attacks surgical patients is apparently the regular disease, ordinarily endemic in this country, since its mode of onset, symptomatology, &c., are very similar. There is one difference, however, to be noted—viz. that the 'surgical scarlet fever' is very rarely followed by kidney-mischief. The only question that can be raised is whether this condition is not really a form of septicæmia closely imitating scarlet fever; but a discussion of this point would lead us beyond the scope of this article, and we can only note the occurrence of the above-de-

scribed condition, as a point to be borne in mind by the operating surgeon. Without doubt, prophylaxis, in the way of preventing all possible means of transportation of the contagion, is the most important practical bearing of the facts here noted, but extra precaution may be taken in the way of observing the temperature for at least a week before operating.

2. Nothing need be said on the liability of the puerperal woman to contract the disease, since such a patient is in the condition of a person after a surgical operation.

3. With regard to the oft-suggested metamorphosis of diseases, such as scarlet fever and erysipelas, into puerperal fever, all that can be said here is, that although, experimentally, septic diseases can be modified under certain circumstances, there is no reason to suppose that one disease can be started by the virus of another; indeed, all carefully noted facts point in the opposite direction. The true explanation of the supposed metamorphosis is, perhaps, that the exanthem, when inoculated into the puerperal woman (and there is of course the greatest danger of transferring the virus of septic disease or scarlet fever to a puerperal patient), sometimes runs a modified course, the modified disease being mistaken for one or other of the varieties of puerperal sepsis.

We must now leave this general part of the subject—viz. classification—and briefly discuss the circumstances attendant on the causation and etiology of the septic diseases, so far as they bear on the descriptions of the different varieties arranged above.

In the first place, we will consider the etiology of sapræmia only, so far as it is connected with the other septic diseases. For a fuller account, see SAPRÆMIA.

It will be obvious, as has already been suggested in the 'definitions' of erysipelas, infective cellulitis, &c., that a large part of the patient's symptoms is due to the secondary action on the system of the inflammatory products resulting from the primary inoculation. These inflammatory products are of importance in two ways. Firstly, by giving rise to tension they cause further stagnation in the blood-vessels, and consequently general diminution in the circulation, thus producing the most favourable condition—viz. rest, for the growth of micro-organisms through the tissues; secondly, among the inflammatory products are the results of the katalytic decomposition of the (albuminous) tissues. Such decomposition-substances are very numerous (see SEPSIN; SCHIZOMYCETES) and of variable

importance. Those of them which alone concern us now are, the ptomaines of cadaveric decomposition, alkaloidal substances which being absorbed into the lymph-stream or blood-circulation give rise to chronic SAPRÆMIA.

To recapitulate, it is clear that in cases of septic disease where the local mischief is considerable, the effect on the patient will be twofold—viz. (a) effect of the specific virus; (b) effect of the inflammatory products in producing a secondary sapræmia. The existence of this second factor explains why, in such cases, early incision and amputation produce such marvellously rapid changes for the better in the general state of the patient—viz. by making a clean sweep of one source of poisoning.

Having thus cleared the ground by eliminating the principal source of complexity in this class of diseases, we may now briefly consider the action of the specific septic poisons, so far as they throw light on the etiology of the septic diseases. It is impossible, in referring to these specific poisons, to altogether avoid entering on the endless question of the nature of the contagion in these cases—i.e. whether it is a living parasitic micro-organism (sometimes absurdly called a disease-germ) or a chemical non-vital substance. As will be seen directly, the evidence, so far, is in favour of the specific virus (which spreads by multiplication) being a pathogenic micro-organism; and, granting this to be the case, we may conveniently abbreviate explanation of the possible modes of action of such an organism, by enumerating the following classification of the possible modes of action of such organisms, a classification suggested by the writer three years ago in a Report on Septic Organisms to the Local Government Board.

1. *Mechanical Mycosis* (mycosis signifying invasion of the system by a fungus), the condition in which the parasitic micro-organism causes some at least of its effects by mechanically plugging blood and lymph vessels.

2. *Katalytic Mycosis* (katalytic signifying a splitting up or decomposition), a term employed here to denote the action of the organisms on the tissues they attack, or the condition in which definite changes are produced in the tissues by the vital processes of the parasitic micro-organisms, divisible into classes (a), (b), and (c).

(a) Where the parasitic organism gradually causes death by absorbing and breaking up, for its own nutrition, the tissues of the host.

(b) Where the parasitic organism, by the katalytic action of its life-processes on the tissues of the host, causes the production of a poisonous ptomaine.

(c) Where the parasitic organism directly or indirectly, by the above-mentioned ptomaine (b), sets up an acute inflammation.

We will now see how far experimental pathology has succeeded in elucidating the conditions of septic disease, for the tedious method of clinical observation has, naturally, done little more than bring the subject into the hopeless confusion indicated at the beginning of this article.

The experimental investigation of the causation of human septic diseases—i.e. pyæmia, &c.—is exceedingly difficult, for animals differ so much among themselves, and more especially one class from another, that no one has yet succeeded in isolating the virus of human pyæmia and septicæmia by the means at present at our disposal—viz. cultivation and inoculation. The last disease, however, mentioned in the foregoing classification—viz. malignant pustule—has been thoroughly investigated, and, its causation being now fairly well understood, we will first describe the virus and its action on animals, as being a typical instance of the pathology of an infective disease.

In the first place, the virus of malignant pustule and woolsorters' disease is a micro-organism, the *bacillus anthracis* (see *BACILLUS*; *SCHIZOMYCETES*, &c.), which from its size and affinity for staining materials, &c., is readily recognised. This organism, when cultivated purely, kills most rodents (guinea-pigs especially) with certainty in about fifty to sixty hours, the quantity inoculated being extremely small (microscopic). The symptoms produced by its spreading through the tissues are scarcely marked during the first day, but the temperature gradually rises, the animal loses its appetite, becomes lethargic, and ultimately dies comatose. The macroscopic post-mortem appearances are those of death from asphyxia, together, frequently, with marked swelling of the spleen (hence the term splenic fever applied to the disease when it occurs in cattle). Microscopically, it is found that the blood-vessels are crammed with bacilli, in many places completely plugging the calibre of the vessel. Here, then, we obviously have our first variety of mycosis—viz. a mechanical mycosis, the actual mass of organisms forming a mechanical obstruction to the blood-circulation, and not only to the circulation merely, but, by being present in such numbers, they must inter-

fere considerably (from that point of view) with the normal metabolic relations existing between the blood-stream and the tissues nourished by the same. Now, the second mode of mycosis, the katalytic form, plays a greater part than the mechanical mode just described, so we must also consider the bacillus as possibly killing—(a) by destroying the tissues of the animal affected, in finding pabulum for the rapidly growing and multiplying organisms; (b) by producing a poisonous ptomaine by the action of the organisms in splitting up the fluids and tissues of the host. As yet we have little positive evidence bearing on this point, but attention is being directed to the question, and already it has been found that various putrefactive organisms growing in albuminous fluids form, by reason of their life-changes, poisonous ptomaines. These bodies are specially referred to in the article on *SEPSIN*.

We have mentioned above that the *bacillus anthracis* may act locally or generally, in the first instance producing the form of carbuncle called *MALIGNANT PUSTULE*, and, in the second, the general disease called wool-sorters' or splenic fever. This leads us to discuss the next point of importance—viz. the mode of entry of the poison into the body. This factor is of especial importance, of course, and particularly so in discussing the probable modes of inoculation in human septicæmia and pyæmia, and, further, since the splendid prophylaxis of antiseptic surgery rests upon a correct understanding of the theories concerning it.

If the *bacillus anthracis* or its spores (the latter, doubtless, being the most frequent condition) be inoculated into the subcutaneous tissues of a man by means of a small scratch, raw surface, &c., it grows in the tissues, exciting (see *Katalytic Mycosis* (c) above) a gangrenous inflammation of a characteristic aspect. See *MALIGNANT PUSTULE*. If, however, it or its spores be inhaled in dust (some of which is probably swallowed) it penetrates the mucous membrane possibly of the air-tubes or the thin epithelial lining of the alveoli, and so gains access to the general circulation. In some instances it distinctly appears to have entered *viâ* the alimentary canal, and particularly through Peyer's patches and the other lymphatic follicles. In applying these facts generally to septic diseases, we find that whether the local effects are most marked, or whether, on the other hand, that general symptoms are the characteristic features of the case, in both the most

usual portal through which the poison gains ingress into the system is the subcutaneous tissue. We may abbreviate what must be said on this point by presenting the following table or list of means of ingress, together with the septic diseases the poisons of which enter thereby:—

ENTRY BY—1. *Subcutaneous and General Connective Tissues*.—Septicæmia, pyæmia, so-called puerperal fever, erysipelas, infective cellulitis, acute spreading gangrene, hospital gangrene, malignant pustule or external anthrax.

2. *Respiratory Tract*.—Woolsorters' disease or internal anthrax, sapræmia, farcy (other pyæmiæ?).

3. *Alimentary Tract*.—Sapræmia, internal anthrax, pyæmia (notably after enteric disease—e.g. typhoid, &c.).

The next question bearing on this point is the difference in the interval of time occupied in the absorption of different poisons. Very scanty information is to be gained from the few experiments devised to solve this problem. Davaine showed that the virus of anthrax was absorbed in a much shorter time (about half an hour) than that of sheep-pox. There can be little doubt that most septic poisons are not absorbed in less than fifteen minutes to half an hour, and that energetic prophylaxis may successfully intervene before the expiration of that interval.

The poison having found entrance, a few lines must be devoted to tracing it in the system. We have seen that our type, the *bacillus anthracis*, in one case grows in the connective-tissue spaces (locally), and, in another, spreads through the blood. Now, in the next septic disease the pathology of which has at last been determined by experiment—viz. erysipelas—the virus, a micrococcus, grows through the lymphatic vessels in the subcutaneous tissue. In the local septic diseases terminating in gangrene, the organism simply spreads through the cell-spaces in the ground-substance of the connective tissue, sometimes apparently invading the corpuscles themselves. On the other hand, in the obscurer diseases, pyæmia and septicæmia, the poison soon enters the bloodstream, and is conveyed thence all over the body. It remains entirely an open question how far the poison in these cases causes mechanical mycosis, but it can readily be shown that it sets up local mischief where it lodges. Most septic poisons develop in those parts of the body where the circulation is least active; hence, foci of the disease are found in the capillary meshes of

the liver, spleen, lungs, the joints, &c. We may, in passing, draw attention to the fact that this agrees with what we know experimentally of the growth of micro-organisms in tissues, and so suggests that, in all septic diseases where the poison multiplies, it is a micro-organism.

It now remains to see how the poison leaves the body. Apparently, in most instances, this is effected by means of the kidneys. That these organs excrete poisons there is no doubt, and from the fact of their being very frequently the seat of active disease in septic cases, organisms being found in the Malpighian glomeruli, in the tubules, and urine, there is good reason to think they play an important part in getting rid of infective poisons. Perhaps most of the excreta contain the virus, but this matter requires further elucidation. As a practical point, for instance, it may be observed that the desquamation of epidermis, after erysipelas, should be treated as infectious material until proved to be otherwise.

Hitherto we have considered the septic poisons without regard to the individual peculiarities of the subject they attack. Thus, to return to our type, the *bacillus anthracis*. This organism is able to attack and kill man, most rodents (excepting some kinds of rats), ungulates, young dogs, not old ones, and yet is powerless when inoculated into birds. If, however, the vitality of the resistant animal is depressed—if, for example, the temperature of birds be lowered by immersion in cold water—they then become susceptible to the disease. This fact illustrates an apparently simple law, the details of which, however, are by no means clear. Complexity is introduced here on account of the possibility that frequent contact with septic poisons may confer immunity. Though this is by no means established, and there are facts reported which contradict it (e.g. cases of post-mortem-room porters, &c., who contract fatal septicæmia, &c.), it must, nevertheless, be borne in mind in considering the circumstances which determine successfully the resistance of an individual to any form of septic disease.

The facts concerning immunity, so far as is definitely ascertained at the present time, are that (1) individual peculiarities in the composition of the blood and its relation to tissue-changes, (2) activity of the tissue-changes (metabolism), coupled with free access to fresh air (complete oxygenation), (3) previous attacks (possibly), are the most important determining factors; but further attention cannot be given here

to this point. See POISONED WOUNDS; SAPRÆMIA; SEPTICÆMIA.

In conclusion, we may fittingly close the illustration of the facts on which the classification of the septic diseases is based, by reasserting the fact that all such diseases can be grouped under the two headings of local and general; such grouping depending upon the nature of the primary effects which follow inoculation.

Treatment and Prognosis.—These vary with each disease, to which reference must be made, as also for description of special symptoms, this article being only an attempt to give a brief arrangement of the septic diseases according to the most modern views. The condition known as blood-ferment poisoning, often regarded as a form of septic disease, is not so, properly speaking, but as it is often confounded with SAPRÆMIA, it will be found described at the end of the article on that condition.

VICTOR HORSLEY.

SEPTICÆMIA is an expression which has, unfortunately, been used in so vague a manner as to make it difficult to understand what is really meant by it. It will be conceded, we believe, by most of those who have paid special attention to the subject of septic disease, that it is too late nowadays to discuss the etymology of the expression, or to introduce the possibly more correctly constructed term, sephthæmia. Septicæmia, possibly from being more euphonious than accurate, is now in general use, and therefore in the classification of the SEPTIC DISEASES, it is retained to denote that variety of septic diseases to which it is most usually applied. To repeat that description here, septicæmia is the name given to an acute (specific) infectious disease, the poison of which is usually inoculated in very small quantities, therefore multiplies in the system, and consequently is probably a micro-organism. Finally, no secondary foci of inflammation occur in the course of the disease. In fact, we have to do with a poisoning of the whole system, most of the symptoms perhaps being due to affection of the central nervous organs, a poisoning which, like that of one of the acute specific fevers, is unaccompanied by any complications, such as thrombosis, endocarditis, &c., which frequently are found in pyæmia.

The form in which the disease appears is variable; the difference between one case and another, however, being apparently only one of degree in the virulence of the poison. It is easy, moreover, to divide the

disease clinically into two main classes—namely, *acute* and *chronic*. Although, in describing the symptoms of these two forms, we must separate one from the other, it will be more convenient to discuss their etiology together for purposes of comparison. Finally, a word must be added here to protest against the popular use of the term septicæmia, to signify the condition described in this work as sapræmia, in which the poison is a simple chemical substance, whose effects in the same individual are solely proportionate to the dose. The indiscriminate application of the term septicæmia to both these very different affections has caused much useless discussion among the learned, and much confusion to students.

Etiology.—That a patient should be the subject of septicæmia apparently one thing alone is required—namely, the inoculation of the virus into the circulation. The general conditions, which regulate individual powers of resistance to septic disease, do not appear to apply with much force in the most virulent forms of septicæmia; but there is one fact which either shows that constitutional peculiarities modify somewhat the course of the malady, or else is indicative of the existence of a specific difference between the acute and chronic forms of the disease. We refer to the observation (frequently made by the old surgeons) that *acute* septicæmia more often attacks people apparently very healthy than bed-ridden patients, while, on the other hand, the latter class are more subject to suffer from *chronic* septicæmia.

Not proposing to waste space by discussing this point, we will pass on to the conditions surrounding the inoculation of the virus. Although, of course, it is highly probable that septicæmia in both forms may arise from absorption of the virus by the alimentary canal or respiratory tract, it appears to be very rarely caused in this way; and, as all the cases which throw light on the clinical history of the disease have been obtained from instances of inoculation into the connective tissues, and possibly also directly into the blood stream, it will be best to describe in detail this mode only of the entry of the poison into the system. 1. *The source of the virus*: this in the very large majority of cases has been some putrid substance (usually the corpse of some person recently dead of a septic disease); next, the disease often occurs as a result of operations performed without antiseptic precautions, in these instances almost always being introduced from with-

but by dirty fingers or instruments, the possibility of its arising autochthonously being very slight. 2. *The dose*: this may be excessively small, practically invisible to the eye, for some of the most fulminating cases have followed a very slight needle-prick; it is this feature in the etiology of the disease which makes the nature of the (to say the very least of it indirect) virus very evident. 3. *The mode of introduction*: this has already been indirectly referred to, and, in brief, consists merely in a wound of the skin which opens the subcutaneous tissue. Punctured wounds are more often followed by infection than incised ones, for the reason that there is but little flow of blood to wash out the poison.

We now arrive at the debatable point whether the poison finds entrance at once into the blood, or indirectly and later by the lymph-stream. It would seem possible that either event may happen, and, if so, it suggests a part explanation why the incubation-period differs in the large majority of cases. *Vide infra*. As a rule, there seems to be no affection of the lymph-glands as a direct effect in uncomplicated cases; swelling and suppuration, when occurring in these structures, being evidently the result of local inflammatory poison inoculated at the same time as the special septicæmic virus. Although this fact is suggestive, we cannot conclude therefrom that the poison is always absorbed directly into the blood-circulation. The poison having gained access to the system, now occupies a certain period of time (the 'incubation' period) before the first symptom manifests itself. The determination, however, of this most important point is beset with many difficulties, since it must of necessity but very rarely happen that an *absolutely uncomplicated* case even of *acute septicæmia* can arise. In a few instances, however, a person, apparently in perfect health, has been inoculated with an excessively small quantity of infective material, and has subsequently developed *acute septicæmia*; in these cases the incubation-period has been found to be from six to eight hours.

It is only right to state here that some authors, including Gussenbauer, regard these cases of short incubation-period as instances of *acute sapræmia*, but, especially in the absence of any reliable work on the micro-organisms of human septic diseases, we consider that this view is completely negatived—(1) by the fact that the dose of a ptomaine necessary

to produce such a powerful effect would have to be very appreciable in quantity of the substance, and certainly not such as could be contained in a minute trace of pus on a needle; and (2) that when a ptomaine produces powerful effects, the incubation-period is usually a twentieth part of that in the case now under discussion. It is impossible, however, to decide accurately the incubation-interval in septicæmia until the virus of the disease has been isolated. Any attempt to form an estimate of the same period in chronic septicæmia, would be infinitely more hopeless, since that condition, so far as we know, is never uncomplicated, and the co-existence of sapræmia will mask the obscurer symptoms of septicæmia. We must, therefore, leave this question, and, after glancing at the mode of excretion of the poison, turn to the symptomatology of the disease. So far as is known (and that is very little), the poison is excreted in the urine, and organisms have been found to some extent in the kidney; if analogy is justifiable, it is possible that the renal tract excretes the poison of septicæmia, just as we know it does the virus of sapræmia.

Symptomatology.—The symptoms of septicæmia differ, in the acute and chronic forms of the disease, rather in degree than in kind, although quantitative differences may appear to be qualitative variations. In the acute form, the patient feels very depressed and ill at the end of the incubation-period; to this is very soon added severe headache, followed by vomiting, and then there frequently occurs a severe rigor, though this latter is not a perfectly constant feature. The temperature now will have risen to 104° or higher, and falls a little each morning of the illness, rising again in the afternoon or evening. For the first two days there is little else to note in the general state resulting from the specific poison, but, within the first twelve to twenty hours, the seat of inoculation will be violently inflamed and produce symptoms due to sapræmic changes or pain, &c. *See SAPRÆMIA*. By the end of forty-eight hours, however, delirium will have succeeded to the headache, and, still later, subsultus tendinum indicates the extent of poisoning which the nerve-centres are subjected to. Alternating with delirium is stupor, and, as the case approaches a fatal termination, this becomes coma—a stage from which the patient is never successfully roused. As might have been expected, the centres in the medulla oblongata gradually fail,

the *respiratory* movements becoming shallower and more frequent, while the *pulse* grows smaller, usually quick and irregular, indicating the gradual weakening of the cardiac centre. Provided no further complication co-exists, acute septicæmia causes death in from four to seven days, the temperature ordinarily falling very rapidly a few hours before death, often subnormally. In addition to the above constant symptoms, others frequently occur, which, however, are possibly due to sapræmic poisoning and not to the specific septicæmic virus. The most prominent of these is diarrhœa, which usually comes on about the second day, and as a rule is not bloody, as in sapræmia.

The effect of the poison on the kidneys is evidenced, in its turn, by a scanty secretion of albuminous urine, the albumin almost always appearing towards the end of the disease.

CHRONIC SEPTICÆMIA.—As will be understood from what has just been said, it is doubtful whether this disease is an uncomplicated condition. The incubation period alone is a matter of complete uncertainty, so that it is impossible to define the limits of the disease. Speaking generally, we may say that a patient, the subject of a wound infected with the septicæmic virus, shows at the commencement of the disease the same symptoms, only much less marked, as in the acute form. However, the disease in the chronic form preserves throughout a subacute progress. The temperature, although constantly above normal, does not rise so high, and the morning remissions of pyrexia are greater than in the former case. The most obvious pathological feature in chronic septicæmia is swelling of the spleen, this organ often becoming enormously enlarged. Swelling of the spleen occurs in every case of septicæmia, acute or chronic, but notice of it has been reserved until now, because it is more easily noted in the subacute form.

The frequency of swelling of the spleen in septic diseases is an extremely important fact, the interpretation of which, however, is proportionately as difficult. Suffice it to say, that the concurrence of leucocytosis, together with profound changes in the other constituents of the blood, is extremely suggestive in connection with the fact of splenic swelling. The other parenchymatous organs, the liver, &c., show marked degenerative changes, commencing as cloudy swellings. Rarer symptoms found are: rashes on the skin, lung-complications, and inflammatory affections of the serous

membranes. With regard to the skin-eruptions, there is no doubt that a scarlatina-form rash not infrequently appears in acute septicæmia, but (*see* SEPTIC DISEASES, Classification of) is not to be confounded with surgical scarlet fever. Much more rarely, papular and pustular eruptions occur, and still more rarely an urticariform rash. Lung-complications are, usually, bronchitis and pneumonia, and finally the serous membranes are invariably the seat of petechial extravasations of blood, their cavities being frequently filled with blood-stained serum, and more rarely with highly infective pus. These conditions give rise, of course, to the ordinary symptoms of pleurisy—*empyema*, pericardial effusion, &c. The other symptoms are the same as those of acute septicæmia, and, in comparison with the latter malady, chronic septicæmia runs a course of nearly treble duration, cases often lasting three to four weeks.

Pathological Anatomy.—The changes in the internal organs, in septicæmia, are naturally relatively very slight where the poison is so extremely infective and rapid in action. We have already indicated the changes in the principal viscera, and have only to add a few additional observations on these points. In the first place, the nerve-symptoms and mental derangement are found to be produced by extreme congestion of the pia mater; similar congestion, and occasionally punctiform extravasation, being found in the deeper parts of the central nervous system. Moreover, the heart is occasionally the seat of ulcerative endocarditis, which gives rise, as usual, to secondary embolism.

Treatment.—It is of little use to point out here the absolute prophylactic value of antiseptic precautions in preventing the absorption of the septicæmic virus, since these are already referred to in the articles on ANTISEPTIC SURGERY and POISONED WOUNDS.

The direct treatment of acute septicæmia is most unsuccessful, which is natural enough when we consider that the virus has not yet been isolated. Proceeding on theoretical principles, we may, for the sake of classification, divide the treatment into local and general.

Local Treatment.—The first thing to do is undoubtedly to destroy what remains of the poison, and to prevent any further formation of the same at the point inoculated; and this is best done by laying the wound freely open, irrigating it with 1 in 20 carbolic acid solution or chloride of zinc, 40 gr. to f̄j., &c., and then treating it with hot boracic fomentations and hot antiseptic baths.

General Treatment.—A vigorous attempt to attack the poison in the system should be made by administering large doses of quinine and salicylate of soda (20 gr. of the former and 60 to 70 gr. of the latter per diem). Warburg's tincture and antipyrin (the latter in 15-gr. doses until the pyrexia is reduced) are likely perhaps to be valuable. Useful adjuncts to the above antipyretic treatment are ice-packs and sponging, and the ice-cap. Special treatment of ordinary kind must be employed for the rarer complications noted above.

For diet, &c., general rules must be followed, and, as regards stimulation, the pulse is to be the sole guide to the administration of alcohol, ammonia, ether, &c.; stimulants only being given when heart-failure is distinctly marked, the depression which follows over-stimulation being particularly dangerous. *See PULSE.*

Prognosis.—Acute septicæmia is commonly regarded as necessarily fatal, unless vigorously treated within the first twenty to thirty hours of the disease, and even then the outlook is extremely serious.

Chronic or subacute septicæmia is a more manageable affection, but probably 50 per cent., if not more, of the cases die.

VICTOR HORSLEY.

SEPTUM NARIUM, Affections of the.—**DISPLACED SEPTUM.**—The displacement is generally the result of an injury such as a fall or blow upon the nose; but it may be due to a congenital defect in development. It may come on spontaneously, either about the second year, when it appears to depend upon an overgrowth of the cartilage at its junction with the vomer, similar to that which occurs at the epiphysal line in rickets, or else a little after puberty, a period at which there is normally a great increase in the growth of the septum. The extent and character of the displacement vary considerably. Thus, the whole septum, especially when the displacement is due to an injury, may be bent to one or other side, or dislocated from the maxillary crest, whilst there is generally, at the same time, some lateral deviation or depression of the lateral cartilages, or more rarely of the nasal bones. Again, the displacement may be limited to the line of junction of the septal cartilage with the vomer, the displaced part then forming a prominent ridge in that situation; or, again, the anterior portion of the septum may be dislocated from the anterior nasal spine, forming an unsightly red prominence just within the nostril. When the displacement is extreme, the septum may

come into contact with the outer wall of the nasal fossæ and even adhere to it, producing complete obstruction of the passage.

Symptoms and Diagnosis.—The patient generally complains of a feeling of stuffiness or obstruction in the nostril on the side towards which the septum is displaced, an alteration in the tone of the voice, and a chronic discharge from the nose. Less frequently he suffers from frontal headache, a feeling of giddiness, slight deafness, and still more rarely from epiphora, epistaxis, and even dropsy of the antrum, symptoms referable to the spread of the nasal catarrh to the frontal sinuses, nasal duct, &c., or to their obstruction by the displaced septum. The red prominence just inside the nostril and the external deformity, however, are, when present, perhaps the patient's chief annoyance. On looking into the nostrils, the displaced septum will at once be seen more or less completely blocking up one of the nasal chambers, whilst, on the opposite side, a corresponding depression will be discovered, and will at once serve to distinguish the affection from a polypus, an hypertrophied spongy bone or a septal growth, for which it has, however, before now been mistaken.

Treatment.—This will depend upon the nature of the case. Where the whole septum is displaced it should be forcibly straightened, and the lateral cartilages or bones, if also displaced, rectified at the same time. For this purpose, the writer's modification of Adams's forceps will be found convenient, as in their use the columna is not injured. In rectifying the bones great force has to be used, but the writer has hitherto seen no harm follow. Should the septum, as is occasionally the case, be very resilient, and resume its faulty position on removing the forceps, its resiliency must be destroyed either by well breaking up the cartilage with the forceps, or by making a stellar incision in it with a properly shaped knife. Whilst the replaced septum is undergoing consolidation in its improved position, some form of retentive apparatus should be used. Thus, for the first few days Adams's screw instrument may be worn, and subsequently for some days longer suitably formed plugs. The writer has of late substituted hollow vulcanite plugs for those formerly employed, so as to allow of nasal respiration being carried on during their use. For retaining the lateral cartilages in position, several contrivances have been invented. The writer uses for this purpose a mask accurately

fitting the face, as affording the best means of obtaining a fixed point from which to bring pressure to bear upon the nose. When the anterior portion only of the septum is dislocated from the nasal spine, a suitably shaped flap of mucous membrane should be dissected up from over it, and the projecting portion be shaved off.

TUMOURS OF THE SEPTUM.—Blood-tumours and abscess have been described in the article on the NOSE. The other tumours that have occasionally been met with are myxomatous, cartilaginous, and osseous, and more rarely sarcomatous and epitheliomatous growths, whilst syphilitic gummata are far from uncommon. The *diagnosis* of these affections is easy if care be given. In blood-tumour, the history of an injury, and the presence of a rounded fluctuating swelling on both sides of the septum, unattended with signs of inflammation, should distinguish it from an abscess, in which there is inflammatory redness, pain and swelling, and often much œdema of the upper lip. Syphilitic gummata may also occur on both sides of the septum. They are at first hard, but softening usually soon sets in, and necrosis and perforation of the septum may result. Concomitant signs of syphilis, the history of their commencement, and the result of treatment, usually serve to distinguish them. Cartilaginous and osseous tumours may be known by their slow growth and excessive hardness, and may be distinguished from a deviated septum by the absence of a depression corresponding to the swelling in the opposite nostril. Sarcomatous and epitheliomatous growths may here, as elsewhere, be recognised by their rapid growth, involvement of surrounding parts, and the other characteristics of malignancy. The microscopical examination of a small portion snipped off the growth should clear up any doubt as to its nature.

The *treatment* of abscess is an early and sufficient incision, so placed as to favour drainage. For syphilitic gummata the usual syphilitic remedies must be employed. Cartilaginous and osseous tumours, if small, may be removed with small bone-scissors, or better with the small circular saw of the dental engine, taking care not to perforate the septum. When large, the growth must first be exposed by ROUGE'S OPERATION, or by one of the other methods of exposing the anterior openings of the nasal chambers described under NASAL POLYPUS; NASO-PHARYNGEAL GROWTHS.

ŒDEMA OF THE SEPTUM NARIUM.—This condition, which is usually limited to the

posterior part of the septum, has only been recognised since the introduction of posterior rhinoscopy; and would appear to be not very uncommon. It gives rise to symptoms of nasal obstruction similar to those produced by nasal polypi far back, or by hypertrophic nasal catarrh. On each side of the posterior border of the septum the mucous membrane appears swollen, forming two whitish, oval, cushion-like prominences, soft and elastic to the probe, projecting into, and more or less blocking up the choanæ, and contrasting strongly with the general red colour of the mucous membrane around. This appearance should at once distinguish œdema from polypus.

Treatment.—Puncture, or tearing away portions of the cedematous mucous membrane with forceps has been recommended; but the best results are obtained by the application of the post-nasal galvanocautery. When the œdema is associated, as it frequently is, with hypertrophic nasal or retro-nasal catarrh, these affections first call for treatment.

PERFORATION OF THE SEPTUM is generally due to the softening and breaking down of syphilitic gummata, and consequent death and separation of the underlying bone or cartilage. Less commonly it results from strumous ulceration or periostitis, or from the erosion of a lupous patch within the nostrils. It may also follow an injury, blood-tumour, or abscess of the septum. Workers of chrome are especially liable to perforation of the septum in consequence, it would appear, of the irritating and corrosive action of the fumes. The perforation in these cases occurs with great rapidity, and generally within a few days after exposure. It is usually preceded by congestion of the mucous membrane, attacks of epistaxis, and a profuse purulent discharge. The discharge, however, has no fœtor, probably in consequence of the antiseptic action of the chrome, a fact which is of value in distinguishing this form of perforation from that due to syphilis. The limitation of the process and its amenability to simple remedies further aid the diagnosis. When the perforation, however caused, is small, it is frequently productive of a peculiar whistling sound during respiration, and when extensive may lead to the falling in of the bridge of the nose, though very large portions may sometimes be lost without this happening. Small perforations may be closed by plastic operation, or if this fails, the opening may be sufficiently enlarged to prevent the whistling.

W. J. WALSHAM.

SEQUESTRUM is a term used for dead bone, when it is quite loose and detached from the living. It is oftentimes used as a synonym for necrosis, but should be more properly employed only as above described. See NECROSIS.

H. H. CLUTTON.

SETONS.—A seton is a sinus produced artificially, and prevented from healing by means of some material passed along the track of it. Setons are chiefly used as counter-irritants, and in that case they are established in the subcutaneous tissue near the part it is desired to influence, e.g. in the temple or behind the ear in certain affections of the eye. As local irritants setons are not now much employed, but they used to be passed through cavities such as chronic bursal effusions and cysts, in order to excite inflammation and adhesion of their walls; in the form of drainage-tubes they are, however, still employed. Setons have also been used as a means of slowly evacuating the contents of chronic abscesses.

The orthodox material to use for keeping open a seton is known as a 'seton-tape,' and consists of a flat piece of gum-elastic tissue; it is introduced by a seton-needle, which is a broad, flat needle, with two cutting edges, and furnished at the heel with a clip, instead of an eye, for holding the tape. Both seton-needle and tape may be dispensed with, and instead of them, ordinary needles with eyes of suitable sizes for carrying one or more strands of wire, silk, worsted, or other material may be used. To establish a seton in the subcutaneous tissue, the skin should be pinched up between the finger and thumb, and the needle passed through the base of the fold, at such a depth that it is entirely below the skin, and the punctures at a sufficient distance apart that the vitality of the bridge of skin be not interfered with. The material used to keep open the sinus should be well oiled, and, after suppuration has been set up, a fresh piece of it should be daily drawn into the wound; if the gum-elastic seton-tape be used, it is only necessary to move it daily and keep it clean. The seton should be covered with some moist dressing, so as to prevent scabbing at the orifices and retention of discharges. If not itself sufficiently irritating, the tape may be smeared with savine ointment or iodine.

BILTON POLLARD.

SEX.—It is not possible to define sex; for it is not only the presence in the body

of certain organs and functions, and a certain state of the nervous system. It is a condition affecting the whole body, from the moment of conception; and the presence of visible sexual organs in the fetus marks not the beginning of sex, but its advanced development. Van Helmont's saying, 'Propter uterum est mulier,' should be 'Propter mulierem est uterus.'

To the surgeon, the sex of a patient may be important in diagnosis, treatment, and prognosis; and sex is included, together with age, habits, and temperament, in that broad general view of each case which distinguishes those who wish to treat the patient as well as the disease. It is also of interest from the limits which it imposes on the transmission of disease and on its distribution, and from its relation to the comparative health and length of life of men and women.

We must first distinguish the *transmission* of disease from the *distribution* of it, and we must consider the influence of sex on each.

The relation of sex to the *transmission* of disease is to be studied in Darwin's *Animals and Plants under Domestication*, chap. xiv., and in Sedgwick's articles in the *Med.-Chir. Review*. It is well shown in those families where deafness, deaf-muteness, or imbecility has occurred among the daughters only. Ichthyosis also has been thus limited in transmission—in three families, to women; in one, to men. A malformation of the left ear has been transmitted to males alone; and malformation of the digits has gone, through ten generations, to females alone; but, in another family, to males chiefly. Albinism has affected only males, and only females. Many defects of the eye, especially myopia and colour-blindness, have been similarly limited; out of a total of thirty-two men and twenty-nine women, belonging to branches of a colour-blind family, there were twenty colour-blind, of whom eighteen were men, and only two were women; but in another family, there were in five generations thirteen persons colour-blind, all women.

Nor are malformations alone thus limited in transmission to one sex; every peculiarity tends to be transmitted in a greater or lesser degree to that sex in which it first appears (Darwin). This is shown in phthisis, and, sometimes, in other forms of scrofula. In these cases, 'the sons or daughters inherit the peculiarity, whatever it may be, from their father or mother, and transmit it to their children of the male sex.'

Or only a certain *disposition* to disease may be transmitted, as in cases where typhoid fever or measles has attacked one sex in a family more than another. Or it may be mere weakness, mere 'inability in one sex or the other to maintain life or to live beyond a certain age,' as in those families where one sex lives, but the other dies. Or, as in one instance (Sedgwick), two diseases may be transmitted, each limited to one sex, each having its proper distribution in the family.

Again, disease may be limited in its transmission as regards the sex *by* which it is transmitted. 'Generally with the hæmorrhagic diathesis, and often with colour-blindness, and in some other cases (gout, ichthyosis?) the sons never inherit the peculiarity directly from their fathers, but the daughters alone transmit the latent tendency, so that the sons of the daughters alone exhibit it' (Darwin). The same tendency, though less marked, has been observed in phthisis; here the father transmits the disease to his son in about sixty per cent. of the cases, and to his daughter in about forty per cent.: the mother transmits it to her son in about forty per cent., and to her daughter in about sixty.

The general conclusion is, that disease tends to remain in that sex in which it first appears, but is often transmitted in a latent state through the opposite sex. To this conclusion must be added Darwin's two rules (*Descent of Man*, chap. viii.): that varieties, which first appear in either sex at a late period of life, tend to be developed in the same sex alone; and that variations, which first appear early in life, tend to be developed in both sexes.

These facts as to the transmission of disease make it evident that sex is, from the very moment of conception, a property of the ovum. Further proof of this may be found in the fact that in all cases of joined twins, as the Siamese and others, the two are always of the same sex, as though there had been a double or imperfectly-divided ovum, and each half had retained the sex which was the property of the whole ovum in the beginning.

If this be so, it is impossible that any influence should, after conception, affect the sex of the fœtus.

THE DISTRIBUTION OF DISEASE.—We must remember the difference between the *transmission* of disease, to one sex, or by one sex, and the *distribution* of it to men and women. The two things are wholly separate. Thus, where deafness and deaf-

muteness have been transmitted to one sex only, it has generally been to girls; but of 534 collated cases, 300 were boys. And colour-blindness may be limited in transmission either to boys or to girls; but of 200 cases, 180 were males.

The influences which decide the distribution of diseases among men and women are many. There are some diseases, as tumours of the breast, which are related to physiological changes in the part attacked. Others, as hernia, are related to the anatomy of the parts. Others, as chorea and hysteria, are related to perversion of the nervous system. Others, as some forms of cancer, are related to age, habits, and work. But in others, as in myxœdema (195 women to 15 men) and diabetes (738 men to 248 women—Brunton) it is hard to see what causes the unequal distribution.

At the moment of birth, male children are at a disadvantage; for they are, on an average, ten ounces heavier and half an inch longer, and their skulls are larger and more completely ossified. This may cause obstruction of the circulation, followed by inspiratory efforts, putting the child in danger of being choked by the fluids in the maternal passages (Hicks, *Croonian Lectures*). Also, hæmatoma is more common in new-born male children (Treves).

Before birth, two dangers beset the child—those of congenital deformity and inherited taint.

Congenital deformity is more common among boys than among girls; the following numbers, from various authors, show this clearly:—

	Boys	Girls
Harelip	44	20
Harelip with cleft palate	17	4
Ectopia vesicæ	14	2
Talipes, four simple forms	229	167
Malformation of rectum or anus	68	32
But on the other hand we have—		
Spina bifida	879	1102
Congenital dislocation of hip	13	47

The rare congenital deformities of the chest (fissured sternum, absence of ribs over the præcordium, malformation of the heart and great vessels) are more common among boys.

It may guide us to a possible explanation of this strangely unequal distribution of the chief congenital malformations, if we divide this list into deformities of the face, deformities of the pelvis, and nervous deformities.

The deformities of the face are, perhaps, more common among boys because of their more advanced cranial ossification; either because some of the total energy of development is spent on the cranial bones at the expense of the facial, or because the greater size of the cranium, and its firmer ossification, tend to hinder union of the facial bones in the middle line.

Dr. Hicks's theory, that male children are more liable to deformities of the anterior median line, and females to those of the posterior median line, is not enough to explain all the facts; for deformity of the rectum and anus, which he says is commoner among girls, is really the opposite; nor is it, anyhow, to be counted among deformities of the posterior median line.

But the fact that arrested development of the acetabulum (congenital dislocation of the hip), and of the pelvic part of the large intestine, occurs mostly in girls, while arrested development of the symphysis pubis (ectopia vesicæ) occurs mostly among boys, may be related to the special shape and purpose of the female pelvis; just as in fetal life the female sacrum is already smaller than the male.

As to the prevalence of spina bifida among girls, it may be due to a less complete ossification of the spine, agreeing with the less complete ossification of the cranial cavity.

As regards hereditary taint, scrofula is equally divided, and so is rickets (but Guérin gives 148 boys to 198 girls). Inherited syphilis is equally divided; but certain forms of it are commoner among girls. Hutchinson, in his work on *Syphilitic Diseases of the Eye and Ear*, gives the following figures:—

	Boys	Girls
Keratitis	38	64
Iritis	5	18
Deafness	6	9

On the other hand, there is some reason for thinking that the rare tertiary forms of inherited syphilis are more common among boys.

In the first two years of life, the more advanced ossification of the skull is disadvantageous, as it is at birth, to male children. When irritation and hyperæmia of the brain occur, as often during dentition, the solid skull tends to increase the effects of pressure, as compared with the more yielding and mobile skull of the female. 'For, where the sutures or fontanelles are late in closing, the effects of dentition are not so severe.' (Hicks). Hence the greater mortality of male chil-

dren from convulsions and from nervous affections of the larynx (Trousseau). Talipes is also related to a similar cause.

In 1866, the deaths registered from convulsions were:—

	Boys	Girls
During first year of life	12,438	9,353
" second "	1,668	1,513
In 1868:—		
During first year of life	11,689	8,905
" second "	1,480	1,367

After the second year, the distribution of nervous diseases between boys and girls becomes more equal. Chorea is more common among girls: 'As 3 to 1, and this proportion is still higher after puberty' (Trousseau). Of 422 out-patients at the Children's Hospital, there were 300 girls to 122 boys (Hillier). Incontinence of urine has a similar distribution; the common nocturnal form of it is more common among little boys, but the grave diurnal form is more common among girls about puberty. So sleep-walking (Chambers) becomes, after childhood, commoner among women.

'The period of puberty produces a greater disturbance, and causes a more rapid general development in the female than in the male. At this time, and at no other, the female, inferior to the male in stature and weight from birth onwards, rapidly catches him up and surpasses him; so that, between the ages of 12½ and 15 or 16, females are both taller and heavier than males. It is probable that this excessively rapid growth, together often with some drain upon the strength from the menstrual flow, renders the female sex an easier prey to tubercle than the male. At 10 to 15, in tables of phthisis drawn from different nations, in all the tables the female deaths are nearly twice as many as the male' (Handford, *Medical Times*, Nov. 1885). At this time also, hysteria, and the imitations of disease, and neuralgia and epilepsy are common among women; so also are anæmia, and malaise, and leucorrhœa, and inability to bear up against infection (Allchin). Some of these, as epilepsy, may also attack males first at puberty. But in women, the catamenia are a guard against disease, as well as a cause of it; thus the freedom of women from gout may partly be referred to the occurrence of the catamenia as a great safeguard (Garrod).

Other diseases, which frequently arise at or near puberty, are exophthalmic goitre (42 females to 8 males—Trousseau; 77 to 12—Beigel); ulcer of the stomach (in 234

cases of perforation, 160 were females—Brinton); and lateral curvature (151 to 22—Noble Smith). But these numbers are drawn from hospital practice, and there is need of statistics of the same diseases among the upper classes of society.

As regards marriage, and its influence on health and length of life, a few lines will suffice for the following statistics, drawn from the French registers by M. Bertillon (*Medical Times*, ii. 71). The deaths per 1,000 males yearly are—

	25-30	30-35	35-40
Bachelors	10	11	13
Married men . . .	6	7	7.5
Widowers	22	19	17.5

And so for all other ages. But very early marriages give results of their own: young married men, aged 18 to 20, die at the same rate as men aged 65 to 70. To women, the gain from marriage is less evident: thus, from 30 to 35, the deaths per 1,000 yearly are 11 single women to 9 married. Of women of 25 to 30, the deaths are 9 unmarried, 9 married, and 17 widows. Of women under 20, the deaths are 7.5 unmarried to 11.8 married.

The calculation of probabilities shows that a man aged 20 to 25 adds five years to his life by marriage, and a woman of the same age adds 4 to her life.

Pregnancy, says Dr. Allchin (*Medical Times*, Dec. 5, 85), though it brings the risks of nervous disturbances, or of albuminuria, only raises the death-rate by $\frac{1}{2}$ to 1 per cent. Primiparæ die at the rate of 1 in 62, multiparæ at the rate of 1 in 124. The deaths of pregnant women, from causes not connected with their delivery, were only 55 in all the year 1883. Among diseases related in some way to pregnancy, and so more common among women, are floating kidney (87 to 10 men—Landau), and mollities ossium (85 females, in whom the disease either appeared during pregnancy, or was modified in its course by this condition—35 others—11 males. See *Erichsen*, ii. p. 307).

The menopause, though it may bring neuralgic pains, flushings, and other congestions, or a revival of slight diseases of girlhood, long in abeyance, may have a good effect on the organism, ridding it of chronic ailments, or stopping the growth of uterine fibroids (Allchin).

Old age, in relation to sex, is best comprehended in a short survey of male mortality and longevity, as compared with female. (See Dr. Allchin's Lectures.) In 1883, of 1,000 persons living, there were

487 males and 513 females; and at all periods of life females are either equal in number to the males, or exceed them. But, for every 100 females born, there were born 108.5 males. Therefore (though this greater number of male births is now somewhat diminishing), there must be a higher male death-rate, and we find that for every 1,000 persons there died 19.5, in the ratio of 20.6 males to 18.4 females. Again, in both sexes, the mortality is becoming less: thus in 1871-80 the death-rate was only 21.27 per 1,000 yearly, which is less than it was in any previous decennium; but while the male death-rate sank only 4.24 per cent., the female sank 6.02. Again, though infant mortality is becoming less, the mortality of adults is increasing; but while the male adult death-rate is increasing for all over 35, the female death-rate is increasing only for those who are over 45.

Hence, the mean expectation of life of a male child at birth is 41.35 years, and of a female child is 44.62. But the mean expectation of annual sickness, estimated by Mr. Sutton, is almost exactly the same for the two sexes:—

Age in years	Weeks of sickness in a year	
	For men	For women
15 to 20666	.666
20 to 25737	.737
25 to 45995	.995
45 to 65 . . .	2.736	2.751

Since women have as much sickness as men, and yet have a lower death-rate, they must either be more favoured by circumstances, or they must also have a superior vitality. Evidence for the latter view may exist in the heavy mortality of male infants, and in the fact that most very old folk are women. Thus, of centenarians, the numbers were, in 1873, 79 to 10; in 1881, 66 to 25; in 1882, 54 to 17 (Humphry, *Lancet*, May, 1885). In phthisis, the statistics of different nations are widely different; in England, during 1871-80, they show that, from 5 to 25, women suffer more; but after this they suffer less than men (Handford); and this also may be evidence of superior vitality.

Here we may consider how, as surgical patients, men and women differ. 'As a rule,' says Mr. Savory (*British Medical Journal*, i. 1873), 'women are unquestionably better subjects, in respect of temperament, for injury or operation, than men; not because they usually have more courage, in the ordinary acceptance of the term, but because they have, in this sense, more endurance. It is the passive, rather than

the active quality, which avails them. If they can do less, they can suffer more. And, again, see the advantage of calmness and resignation as opposed to impatience and restlessness. A man will often meet the suggestion of an operation as a soldier will volunteer for a forlorn hope, while the hint of such a thing to a woman will sometimes prostrate her. But then each has to submit to it, and, when the thing is done, as time goes on, qualities of another kind come into play, in which, in her turn, the woman surpasses the man.'

'Persons of an irritable and nervous disposition do not bear operations so well as those of a more tranquil mental constitution. Those also of a feeble and irritable habit of body, especially nervous and hysterical women, with but little strength of circulation, cannot bear up against severe surgical procedures, and often sink after comparatively slight ones; being apt to become depressed and to sink without rallying' (Erichsen).

As regards operating during the catamenia, Mr. Savory says: 'If the period of the catamenia has been miscalculated, or they appear irregularly at the critical moment from anxiety or excitement, much must depend on the patient and the disease; but I believe that by running whatever risk there is, I choose the less evil of the two.' 'As with menstruation, so, much more, during pregnancy, you would not willingly operate. And yet, with the exception of the danger of producing abortion, I know no facts that would imply a greater than the average risk; while it would be mere recklessness to operate on such patients without good cause, yet if good cause for operating exists, they may be treated very hopefully. When women are suckling, they will bear operations with no more than the common risk that might attach to persons who may be in comparatively feeble health. But an exception must be made, I believe, for operations on the breast' (Sir J. Paget, *Clin. Lectures*).

Last, as regards the relative frequency of a few of the chief diseases.

1. Stone in the bladder is especially rare in female children. Among men and women the proportion is 1 to 20, or more, of cases operated upon. 'Owing to the shortness and large size of the urethra in females, many small stones are voided by them that would be retained in the male' (Erichsen). Perhaps the prevalence of tumour in the male bladder (eighteen out of twenty cases—Thompson) may also be related to the anatomy of the parts concerned.

2. Of rectal diseases, fissure, prolapse, and stricture are commoner among women: of 28 cases of stricture, 20 were women; 'and in 9 of them the disease commenced after labour, in some instances being distinctly attributed to an injury at that time' (Curling). But piles, fistula, and cancer are commoner among men; cancer, from different authorities, is 44 to 23.

3. *Hernia*.—Mr. Birkett has constructed the following table, from Mr. Kingdon's statistics in 1860-61:—

Ages	Inguinal		Femoral	
	M.	F.	M.	F.
1 to 20 . . .	2,435	249	23	38
20 to 40 . . .	2,954	322	139	432
40 and upwards	2,154	128	144	278

4. *Aneurism*.—All diseases related to arterial degeneration are commoner in men—e.g. angina pectoris (80 to 8—Forbes; but see Trousseau, *Clin. Med.*, vol. i.) and senile gangrene. Of Crisp's 551 cases of aneurism, more than seven-eighths were in men. But aneurism of the carotid, and internal aneurisms, are more evenly distributed.

5. *Rodent Ulcer*.—Of 42 cases, 20 were women (Hutchinson, *Medical Times*, Oct. 1860). Of cancer of the lip, Hutchinson gives 127 cases, including 5 of the upper lip or angle of the mouth. Of these 127, only 6 were women; and 3 of these women were smokers. As regards cancer of the tongue, Sibley, in 1857, gives 9 men to 5 women; Hutchinson, in 1860, gives 13 to 6; Humphry, about the same year, gives 7 to 9; Baker, in 1862, gives 19 to 11. But a recent set of private cases gives 44 to 2; and the cases in St. Bartholomew's Hospital in 1883 were 23 to 1. (Compare Mr. Barker's tables in Holmes's *System*.)

Mr. W. R. Williams has just published full statistics of the distribution of the various diseases, medical and surgical, to men and women, in his valuable work, *The Influence of Sex in Disease*.

STEPHEN PAGET.

SHAMPOOING. See MASSAGE.

SHOCK.—*Etiology, &c.*—Shock is that state of general depression of vital activity, into which a person passes who has been subjected to severe injury, emotional disturbance, &c.; or, in other words, who is suffering from the general depressing effect produced upon the central nervous system by a violent stimulation of the peripheral nerves and nerve-endings.

The general effect of the excessive 'irritation' of the central nervous system will consequently, *cæteris paribus*, vary directly

with the degree of the stimulating force, as will presently be shown to be the case, while, at the same time, this effect is modified by the very obvious differences between the circumstances of individual sufferers.

The condition, in most cases, is not merely produced through direct irritation of the nervous system, but is very frequently deepened, and the symptoms rendered much more severe, by such simple though fundamentally important complications as exposure to cold, loss of blood, previous acute illness, &c. In fact, the first two of these predisposing conditions are to be looked upon occasionally as themselves causes of shock, and will be referred to as such below.

The effect, moreover, is not always the same, although the exciting cause may be identical, for two distinct kinds of shock were observed by Travers—viz. one in which great prostration is the principal feature of the case, and another in which the patient, although apparently exhausted, passes into a condition of traumatic delirium. The consideration of the latter of these, termed prostration with excitement, will be postponed until the more ordinary case of depression has been described.

I. SHOCK WITH DEPRESSION.—*Causation.*—(1) *Seat of Injury.*—Shock is especially apt to follow injuries of the head, abdomen, urethra, testicle, digits, and thorax. Thus, it occurs as a result of lesions of those parts which are most richly supplied with sensory nerves, and also those which contain the most important viscera, and are consequently intimately connected with the medulla oblongata by means of the vagus (and trigeminus) nerve. The liability of urethral operations to be succeeded by shock, is undoubtedly due to the intimate relation between the lumbar enlargement of the spinal cord and the process of excretion of the urine. See URETHRAL FEVER.

(2) *Mode of Injury.*—The commonest kind of injury which produces shock is the result of a crushing force applied to the body—one, therefore, which damages a number of branches of the sensory nerves. For the same reason, blunt and large instruments cause shock by the wide area over which they operate, and also from the fact that they inflict a contused or lacerated wound, which causes more energetic irritation of the nerves. So with burns of the surface of the body: it is an old axiom that the important factor in the causation of fatal shock, in these cases, is not the depth or degree of the burn so much as the extent of the injury.

The converse injury—namely, cold—probably acts in the same way, and is a powerful adjuvant in helping to produce shock in operations, which from their nature and seat would not specially cause it. Here it may be noted that Hewson found shock to be most severe in the extremes of winter and summer—i.e. when the system is most depressed.

But while the influence of the extent of the injury has been long recognised, further inquiry shows some particular operative measures to be more active than others in producing this condition, and these may be summed up as those which involve laceration of the nerve-fibres. Thus, Mr. Jordan has shown, in cases of amputation, the strikingly sudden effect produced on the pulse and temperature by the simple act of sawing the bone; so that while the rapid division of the soft parts with a keen-edged knife had very little effect on the narcotised nerve-centres, the laceration of the few osteal nerves caused immediate and marked depression. This phenomenon is not very comprehensible, except on the assumption that it is the mode of injury which wholly determines the effect, when it is remembered that division of a bone with the saw is not a very painful process, unless the section be carried through the bone near the point of entrance, into the marrow, of the trunk of the nerve supplying it.

A practical illustration of the same fact is noted by Pirogoff, who, in the days before anæsthesia was employed, observed that patients sank with extraordinary rapidity immediately after division of the bone.

(3) *Influence of Age and Sex.*—The question as to whether either sex is less liable to shock, is quite indeterminable with our present means of information, and any surgical procedure should not, consequently, be based upon such generalisations—as, for instance, the fact that women do not, generally speaking, meet with so severe a struggle for existence as men, and therefore have a greater reserve of power to fall back upon—but must be decided upon according to the peculiarities of each case. As for the influence of age, all surgeons are agreed as to the especial severity of shock when it occurs in people already the subjects of senile degeneration, it being of course understood that such degenerative change is not necessarily the accompaniment of prolonged life.

As regards the occurrence of shock in children, it is to be observed that, like adults,

they suffer extremely from the causes of shock when those causes are applied over a large area of the body, as for example in cases of burns and exposure to severe cold. In fact, their liability to suffer under these circumstances would appear to be greater than in the adult. As far, however, as operative measures alone go, there is no doubt whatever that the nervous system of the child is less influenced by traumatism than that of the adult. Elaborate clinical evidence in illustration of this point is not to hand, but its general truth, being supported by abundant experimental evidence, cannot be doubted, and is therefore to be considered as forming safe ground for action under circumstances of doubt.

(4) *Nervous Temperament.*—In all neurotic, excitable subjects, the effects of shock are naturally more severely felt, and, on this point, may be mentioned the changes, in the time of onset and duration of this condition, which are wrought by the mental condition of the subject at the time of receiving the injury. Thus, if the patient is harassed by expectation, from actual foresight, of the impending mischief, the effects will develop with great rapidity and cause urgent symptoms. On the other hand, if the patient's mind is attentively occupied with some idea of absorbing interest when he is injured, the symptoms of shock will be postponed, but will be more marked when they do occur, owing to the previous exhaustion of the nerve-centres. Such cases are of common occurrence after battles, &c.

(5) *Previous Loss of Blood.*—This acts so obviously as a predisposing cause of shock—viz. by depleting the nerve-centres—that it needs only mention here; at the same time it should be remembered that the failure of the heart, which occurs in cases of severe hæmorrhage, and which therefore gravely deepens the symptoms of shock, is in many cases due simply to emptiness of the heart's cavities, and thus its urgency can be removed by transfusion. See *Treatment*.

(6) *Previous Illness.*—The effects of previous illness upon the occurrence of shock vary according to the following simple rule—namely, that where previous illness has not caused any visceral disease or degeneration, and has (owing to treatment, &c.) practically only had the effect of confining the patient to bed, so far from predisposing to shock, it is a prophylactic against it. Where, on the other hand, it can be shown that previous illness has caused chronic changes, especially in the excretory

organs, severe shock is to be expected. This fact is, of course, of great importance in deciding the propriety of performing a severe operation upon a case of long-standing joint-disease, &c.

Symptoms.—A person, who has been subjected to one or more of the foregoing causes of shock, exhibits the following symptoms, which are here classified according to the anatomical centres, the derangement of which leads to their production.

General Neurotic Symptoms.—The patient lies flat on his back, usually conscious but not emotional, and exhibiting all evidences of general paresis of volition. Thus, the limbs lie flaccid, usually just where they are placed; he makes no so-called spontaneous movements; the upper eyelids fall so as to half-close the (frequently upturned) eyeball. The eyes are sunken, the skin of the face expressionless and showing well-marked longitudinal folds. The sphincter ani is usually relaxed, and the urine retained in the bladder. Speech is clear, but feeble and sometimes slow, while the intellectual operations preceding an answer to a question are often delayed, and ability to think and reflect, for even a short time, is abolished.

Bulbar Symptoms.—Frequently, no doubt, as an effect of direct reflex action on the vagus centre (cardiac centre), the pulse, slow (according to Jordan) soon after the injury, becomes frequent and remains so till death in fatal cases, as if, apparently, the inhibitory action of the vagus centre were removed. At the same time, it is irregular both in force and rhythm, the force gradually diminishing until the pulse becomes imperceptible, the respiratory movements continuing.

Respiratory Centre.—Respiration throughout is enfeebled and the action of the centre becomes irregular, while inspiration is often accompanied by sighs of variable depth and frequency.

Vaso-motor Centre.—Cases of shock are so frequently complicated by hæmorrhage, that it is difficult to accurately account in all cases for the customary pallor of the skin and mucous membranes; as far as can be made out, there is, first, vasal constriction, which, however, is soon followed by paralysis of the vessel-walls, so that while most of the surface of the body is of a dead white colour, certain portions are darker and even cyanotic, which condition is also kept up by the feebleness of the circulation.

Temperature.—The temperature of the body is customarily lowered from one to three degrees, in fatal cases frequently sink-

ing below 95° F. In some cases which end fatally, the temperature has been observed to rise again after the preliminary fall, and it may even reach 99° before death, the other symptoms also undergoing slight relaxation.

Deglutition Centre.—Voluntary swallowing is impaired, as are all voluntary acts, but the centre in the medulla for the constrictor action of the pharynx, &c., remains active, except in very severe cases, when its function may be abolished.

Vomiting Centre.—The sensation of nausea, which is felt by persons who are suffering from impending syncope, finds its highest illustration in the vomiting produced by shock. The occurrence of vomiting is very variable in time, but very constant in appearance. Thus, it may occur very soon after the accident or at any period afterwards, when some of the other symptoms have disappeared.

Sensory Symptoms: Special Senses.—The perceptive centres, &c., for the special senses are usually unaffected, except in very severe cases, when there may be almost complete anæsthesia and analgesia. Indeed, severe operations have been painlessly performed in this condition, even while the patient was watching all the details. Sometimes paræsthesiæ are well-marked, and sensation of cold (frequently, of course, of actual objective origin) and numbness are complained of.

Miscellaneous Symptoms.—Owing, probably, to vaso-motor changes rather than to direct activity of secretion ('paralytic'?), the skin is moistened by a cold clammy sweat, which occasionally collects in large drops, but, as a rule, is less marked than is usually stated. In accordance with this view, it is to be noted that secretion from other glands is arrested; thus, for instance, there may be absolute suppression of urine.

Pathological Anatomy, &c.—Besides the anæmia of the body-surface, described above, there is also found, in many cases, anæmia of the central nervous system, while the heart is in a state of diastole and the right side full of dark blood. The veins of the abdominal viscera are also said to be engorged, and, if the case is one of uncomplicated shock and one in which the splanchnic system is obviously engorged, we have an easy explanation of many of the vaso-motor symptoms; but on this point post-mortem evidence is by no means complete. In three cases of simple shock examined by the writer, the mesenteric vessels were not markedly full at all. Of course, if there were reflex paralysis of the splanchnic

nerves, or depression of the vaso-motor centres governing the splanchnic vessels, then it is quite probable that the anæmia of the surface and the brain is due to the blood filling the dilated visceral vessels. As the symptoms, however severe, have been shown to be due to simple diminution of function, it is not surprising that no grosser changes than those just described are to be found in this condition.

Diagnosis.—Confusion of this condition with others is scarcely possible, save with concussion of the brain and syncope. Since in the former we have, as the principal effect, diminution of function of the central nervous system, the two states are really nearly identical and do not require separating except for purposes of treatment. General considerations will always suffice to decide, and Fischer points out that the pulse is a fair guide to differentiate the two conditions, being slow and regular, often full, in the case of direct injury to the brain, small and irregular in cases of shock. The complication of anæmia from loss of blood will be easily discovered, and treated accordingly.

Prognosis.—The prognosis depends so entirely on the details of each individual case, that nothing can be said here save that all judgment must be based solely on the evidence afforded by the pulse and temperature. There is, however, a most important prognostic question connected with shock, which may fittingly be discussed here—namely, at what period and under what circumstances is it justifiable to operate upon a person suffering as above described.

First, all surgeons are agreed that it is in no sense justifiable to operate on a person the subject of shock, except in the special case when it is perfectly clear that the damaged portion of the body is (by causing pain, &c.) prolonging and adding to the severity of the condition. Guthrie laid down, as a practical rule, that the surgeon should wait until the patient recovered his sensibility to the pain of the injury, or, in other words, until reaction or gradual recovery has led to the nearly complete re-establishment of function in the nervous system.

Next, most surgeons are now agreed upon the fact that an anæsthetic does little to deepen shock. It certainly depresses the temperature of the body, but equally certainly appears to give rest to the nerve-centres in their progress to recovery, and of course to a large extent protects them from experiencing further depression. Therefore, we may clear the ground by saying that anæsthetics should always be

given, and further, that as a rule ether is the best narcotic agent to employ, since it is at the same time a powerful cardiac stimulant.

In short, the ordinary practice is to wait for some reaction except in the case referred to; but, in all instances, the consideration of the peculiarities of each case will guide the surgeon in modifying the application of these principles, which consequently can only be expressed in general terms.

Treatment.—The treatment of shock may be very conveniently summarised under the following heads—Pulse, Respiration, and Temperature, it being understood that the cause of shock has been removed as far as possible.

Pulse.—The pulse practically is the main guide in the direction of treatment, especially as it affords direct evidence of the condition of the heart, failure of the action of which appears to be almost always the immediate cause of death.

The choice of stimulants, alcoholic or otherwise, must depend upon the degree of shock, the mode of injury, and the state of the patient's heart, &c. If there is not much nausea, hot strong beef-tea should be given in small quantities by the mouth, or if vomiting has already set in, it must be injected into the rectum, the anus being plugged if the sphincter is relaxed. Ammonia (liq. ammon. aromat. f3j.), ether (f3j. in aromatic water), alcohol f3j. (as brandy or champagne, preferably the latter), may be given every half-hour (more or less frequently according to the necessities of the case) until the pulse is improved. The pulse must be carefully watched, and the stimulant diminished as soon as the quality of the heart-beat is improved. In this way, post-stimulation, depression, and over-excitement of the heart's action will be avoided. If the injury or operation is causing much pain and therefore reflex depression of the heart, morphia (gr. 4) should be given hypodermically, and the dose increased if not sufficient, but it must be remembered that the action of morphia is cumulative.

The momentary application of a very hot cloth or plate to the cardiac area will often spur up a sluggish heart, and in severe cases hypodermic injection of ether should be given, f3ss. to f3j.

Respiration and Temperature.—The bodily heat and the respirations commonly vary together, and, as they are intimately connected with one another causally, may be considered in terms of the temperature. If the temperature falls, loss by radiation

must be prevented, the patient must be well but lightly covered with blankets, and hot bottles put by his extremities, and one on each side of the thorax. (It will be remembered that sensibility to pain may be deadened, and that hot bottles must be guarded from the skin.) As soon as the temperature of the body returns to normal and remains so for about half an hour, the hot bottles should be removed or only left at the feet.

Hæmorrhage.—So much of the urgency of shock being due to loss of blood, it is necessary to consider the two immediate effects it exerts on the system. The first of these is insufficient supply of blood to the nerve-centres (bulbar especially), with the production of dyspnea and, often, jactitation as symptoms; while the second is cardiac failure owing to the heart-cavities being insufficiently filled with blood.

The first condition is best met by lightly bandaging and raising the limbs, while artificial respiration is kept up gently but industriously. In one case in which the natural respiratory movements ceased three times, recovery was ultimately obtained by this method. The second symptom, which is sometimes accompanied by a semi-comatose state, must be treated by bandaging and raising the limbs as before. If this does not speedily (fifteen minutes) produce a change in the heart-beat, transfusion should be performed at once. It is not necessary to use blood for this purpose; several saline fluids have been used with success, and one consisting of water 1000 parts, pure sodium chloride 6 parts, sulphate of soda 2 parts, carbonate of soda 1 part, appears to combine the advantages of most which have been put forward since Schwarz established the scientific value of the operation. A quantity equal to the amount of blood supposed to have been lost should be injected into a vein, after careful filtration and warming. Not less than 500 cubic centimètres should ever be injected. *See TRANSFUSION.*

Prophylaxis.—When shock is to be expected to follow an operation, the patient should be given a small dose of morphia (gr. 4) hypodermically a quarter of an hour before the operation, and then the limbs should be lightly bandaged with cotton-wool.

II. SHOCK WITH EXCITEMENT.—*Pathology.*—Travers, who first drew attention at any length to the condition which passes under the above title, considered that the nervous system was affected, as in the ordinary case of shock, by depression with

atony; but that, instead of this ending in paralysis, it passed into a state of hyper-excitability which led to absolute exhaustion. In fact, he described the condition as one of premature and excessive 'reaction.' The pathology of this certainly rare condition has been rendered rather obscure by some writers, who have clearly included under the same heading distinct cases of sapræmia. In the majority of instances, it will be found that the first symptoms appear very early—viz. two to four hours after the operation, that the excitement rapidly reaches a violent degree, and that the fatal coma follows in from fifteen to forty-eight hours after the accident or operation. From this, it does not seem unscientific to conclude that the whole series of phenomena are those of atonic hyper-excitability of the nerve-centres, although it is always to be remembered that there is almost invariably an open wound, and always some extravasation of blood; so that, the possibility of the symptoms being due to pyrogenic absorption never being absent, the question of its true pathology must be left entirely open.

Symptoms.—The patient usually recovers rapidly from the anæsthetic, speaks very hopefully of his condition, and seems in a very favourable state. In a very few hours, however, he will be found to have distinct delusions (the same thing is often seen in patients recovering from the effects of ether), and to be suspicious of those around him. He talks volubly and soon quite incoherently, the respirations are hurried, the apex-beat thrilling and the pulse weak; he tries to get out of bed, is evidently insensible to pain, as he tears off dressings and freely moves the injured part. In this state of excitement the patient cannot be calmed by reason, and finally becomes wildly maniacal. As a rule, very little force is required by way of restraint, as the muscular power is so much reduced. After some hours the signs of shock with depression gradually come on, the pulse becomes very small and quick, the temperature falls, the pupils dilate, &c., and the patient dies exhausted. In some cases, the maniacal state is interrupted by short intervals of comatose apathy and exhaustion.

Prognosis.—Practically fatal, and the condition continues till death.

Treatment.—Nothing has been added to the treatment advocated by Travers—viz. opium, food, and stimulation. Any narcotic to the nervous system, such as hyoscyamus, chloral, paraldehyde, may be tried, but probably without much success.

VICTOR HORSLEY.

SHOULDER, Diagnosis of Diseases and Injuries about the.—The angle of the shoulder is formed by the acromion process of the scapula and the outer extremity of the clavicle, whilst rotundity is imparted to it by the upper end of the humerus and the deltoid muscle. Broad square shoulders are usually taken to indicate manly strength, and depend on a wide chest, long clavicles, and well-developed deltoids; while sloping narrow shoulders indicate delicacy. One shoulder higher than the other is nearly always due to LATERAL SPINAL CURVATURE. It is common in girls about the age of puberty, but usually takes origin in rickets of an early period, and at this climax becomes more pronounced as the result of habit or weakness. High shoulders may so appear because associated with a congenitally short neck, but, when amounting to deformity, they usually indicate ANGULAR CURVATURE OF THE SPINE in the upper dorsal or cervical region. Drooping forwards of the shoulders gives rise to projection of the posterior margins of the scapulæ, and is a sign of *general muscular weakness* such as is seen in too rapidly growing youth and in the decadence of age. Drooping shoulders and rounded back, the so-called 'round shoulders,' are also frequently the result of CYPHOSIS. An oblique direction of the scapula may result from paralysis of the serratus magnus, and rotation with projection of the lower angle from slipping of the latissimus dorsi muscle.

A fall on one shoulder may give rise to fracture of the clavicle, dislocation of the acromio-clavicular joint, fracture of the acromion, dislocation or fracture of the upper end of the humerus, or fracture of the neck of the scapula. *Fracture of the clavicle* occurs most frequently just externally to the middle; the shoulder drops downwards and forwards, and the outer fragment is almost invariably below the inner. The line of fracture can be felt, and crepitus can be elicited by drawing back the shoulder. Fracture between the ligaments (conoid and trapezoid) may be attended with no displacement, and is then to be detected only by pain and crepitus. See CLAVICLE, Fracture of the.

In *dislocation at the acromio-clavicular joint*, the acromion process is almost always displaced downwards and inwards beneath the clavicle, and the outer extremity of the latter forms a well-marked projection above the point of the shoulder. In the rare cases in which the acromion is displaced upwards, its free end can be readily felt

riding over the clavicle. *See* SCAPULA, Dislocations of the.

In *fracture of the acromion* the outer fragment drops with the shoulder; the interval can be felt, and pain and crepitus will be produced by pressing up the head of the humerus. The acromion is sometimes united to the spine of the scapula by fibrous tissue, and, if the surgeon is in doubt as to this condition, he should examine the other shoulder, as the condition is usually symmetrical. *See* SCAPULA, Fracture of the.

An angular appearance of the shoulder may be due either to atrophy of the deltoid or to displacement of the upper end of the humerus. *Atrophy of the deltoid* may be consequent upon disease or ankylosis of the shoulder-joint; it may follow injury to the muscle or to the circumflex nerve; in children it may be due to infantile paralysis, and in adults to progressive muscular atrophy. When due to paralysis, the joint-movements are free.

Dislocation of the head of the humerus invariably renders the angle of the shoulder more acute; this appearance is most marked in the subglenoid, and least evident in the subspinous form. Further, there is limitation of movement, the elbow projects from the side, and the head of the bone can usually be felt in one of the four characteristic positions. *See* SHOULDER-JOINT, Dislocations of the.

Fracture of the neck of the scapula is met with in two forms, both of which are rare. In the commoner form, the coracoid process is broken off with the glenoid cavity and is movable; in the other, the fracture is external to the coracoid process, which remains fixed. The shoulder is more angular than normal from dropping of the humerus with the glenoid cup, but there is no fixation, and the arm is lengthened. Crepitus is obtained by pressing up the humerus; at the same time the deformity disappears, but recurs when the force is withdrawn. *See* SCAPULA, Fracture of the.

Fracture of the surgical neck of the humerus is not uncommon, and gives rise to a marked deformity. The upper fragment is displaced upwards and outwards by the muscles attached to the great tuberosity, and immediately beneath it there is a slight depression; whilst the lower fragment is drawn in beneath the coracoid process, where it can readily be felt, especially when the elbow is raised upwards and outwards. There is increased mobility, and crepitus is elicited by extension, the deformity recurring when extension is removed.

Separation of the upper epiphysis of the humerus may occur under the age of twenty. The deformity is the same as in fracture of the surgical neck, but the end of the lower fragment is less angular and bony crepitus is absent. *See* HUMERUS, Fractures of the; SEPARATION OF EPIPHYSES.

Diseases about the shoulder are numerous, but less complicated than the results of injury. *LIPOMATA* are not uncommon; they are painless, movable, semi-fluctuating, but feel solid and lobulated when pressed laterally. A *BURSA* is sometimes met with on the point of the shoulder in those who carry weights; it is adherent, has a thickened margin, and a fluctuating centre which yields clear glutinous fluid on puncture. *GUMMA* may be met with at the back of the shoulder; the history and concomitant tertiary signs of syphilis would assist the diagnosis. *SEBACEOUS CYSTS* are known by their relation to the skin, which they thin out and are adherent to; they fluctuate, and the skin is often discoloured over them. *HÆMATOMA* or *ABSCESS* may follow injury. Other tumours commencing in the superficial structures are rare.

On the bones *nodes* (*see* SYPHILIS) may occur, attacking either the clavicle, acromion, spine of the scapula, or humerus. They cause thickening, pain at night, sometimes fluctuation and tenderness, and are associated with other syphilitic symptoms present or past. *EXOSTOSES* are known by their slow growth and extreme hardness; *ENCHONDROMATA* by slow growth and rounded elastic nodules on the surface. *SARCOMATA* are more uniform on the surface and of more rapid growth; they sometimes lead to spontaneous fracture. *Myeloid sarcoma* may attack the upper extremity of the humerus in young persons, gradually expanding and absorbing the bone till a thin shell-like layer is left, or only periosteum.

Inflammatory conditions of the bones are at first associated with local or general fever, and, should necrosis follow, sinuses will form, and new bone be deposited around the old. *See* PERIOSTITIS.

Disease of the acromio-clavicular joint is very rare. The joint being subcutaneous, the consequent swelling is readily detected. The writer once saw this joint suppurate in the course of pyæmia.

Sprains and injuries of the shoulder-joint are apt to lead to pain and limitation of movement, lasting for weeks or months, accompanied by *circumflex neuralgia*. This neuralgia is especially felt about the middle of the outer side of the arm, over

the insertion of the deltoid, where the circumflex terminates in cutaneous filaments. In consequence of the deltoid covering the shoulder-joint, *SYNOVITIS* causes no very characteristic appearance, but when the effusion is great, swelling may become evident below the acromion behind, and external to the coracoid in front.

Chronic disease of the *SHOULDER-JOINT* gives rise to muscular fixation, which causes the scapula to move with the arm, a sign of the utmost importance when examining a child. In a young person of strumous diathesis, the joint-disease may take the form of *pulpy degeneration of the synovial membrane*, or it may be that the disease commenced in the bone as *strumous epiphysitis* or *articular ostitis*, and extended to the joint. In the cases of pulpy disease, there is usually a doughy white swelling about the joint, and little pain till the later stages, when the cartilage has been removed; whereas in epiphysitis or articular ostitis the pain is severe, and the swelling at first confined to the region of the bone. *Syphilitic epiphysitis* occurs in infants the subject of inherited syphilis, and gives rise to 'pseudo-paralysis.' Sometimes the epiphysis becomes separated, when increased mobility and cartilaginous crepitus may be detected on manipulation.

The foregoing inflammations have a tendency to suppurate in the later stages, whereas the *rheumatic*, *gouty*, *ataxic*, and *osteo-arthritis* have little tendency to suppuration. The rheumatic and gouty may be referred to the constitutional habit; the ataxic (Charcot's joint-disease) is associated with locomotor ataxy; and osteo-arthritis occurs most frequently after the middle period of life, and gives rise to a creaking joint having bony outgrowths around. All chronic diseases of the shoulder-joint lead to wasting of the scapular muscles.

Subdeltoid bursitis may be confused with joint-inflammation. It gives rise to a uniform fluctuating swelling beneath the deltoid, and pain is felt during active movements in which this muscle contracts, but passive elevation of the arm relieves the pain.

R. CLEMENT LUCAS.

SHOULDER-JOINT, Amputation at the.—Amputation at the shoulder-joint is one of the greater surgical operations, which, as a rule, is attended with excellent results. The cases indicating it are compound comminuted fractures (frequently the result of gunshot injury), malignant tumours, extensive necrosis, and aneurism. They are, in truth, so various that no one method can

be specially recommended. These amputations are six in number—(1) The circular method (Alanson, Velpeau); (2) the oval method (Larrey); (3) the antero-posterior flap method (Lisfranc, Desault); (4) modified oval method (Spence); (5) external square-shaped flap (La Faye, Richeraud); (6) semicircular flap by transfixion (Dupuytren).

To Alanson is due the credit of having first performed and described amputation at the shoulder-joint by the *circular method*, the principle of oblique division of the muscles being adhered to. He commenced the circular incision through the integuments a hand's breadth below the acromion, and then obliquely divided the muscles up to the capsular ligament. 'The tendon of the biceps and the capsular ligament upon the anterior and posterior part of the joint were now cut through. One of the circumflex arteries, which bled a good deal, was next tied. The great pectoral muscle, the rest of the capsule, and all the other parts except the vessels and nerves were then divided, but previously to cutting the vessels a temporary ligature was put around them.' This operation with slight modifications has been practised and advocated by several operating surgeons of repute, notably by Velpeau, who believed that no method gave better results or could be performed with greater expedition than the circular. However, notwithstanding these high credentials, this operation is now seldom, if ever, performed, chiefly on account of its being, as Mr. Lane observes, 'more difficult of performance than the other methods.'

In cases of fracture or tumours of the arm indicating amputation at the shoulder, the *oval method* of Larrey, or Spence's modification of it, is preferable. The former is thus performed. A straight incision is made on the outside of the shoulder, from the tip of the acromion vertically downwards for a distance of an inch and a half or two inches. The deltoid is thus divided into two equal parts. The integuments being drawn up towards the shoulder by an assistant, the anterior and posterior flaps are formed by 'two oblique strokes of the knife made from within outwards and downwards, so as to cut through the tendons of the pectoralis major and latissimus dorsi.' The flaps are then raised and the joint exposed. An incision over the head of the bone divides the capsule and tendons in immediate connection with the articulation. The head of the bone being rotated outwards, the posterior ligamentous structures are divided; the knife is then carried

downwards and outwards through the incision on the inner side, an assistant at the same time compressing the artery in the flap; and finally the knife is directed backwards, dividing the axillary vessels. These are then tied, the divided circumflex vessels being subsequently secured.

Mr. Guthrie has also described a method of amputation at the shoulder by an oval incision, which in the main is closely analogous to Larrey's operation.

The late Prof. Spence, of Edinburgh, described a modification of Larrey's operation, which it is alleged, results in a more shapely stump, and in which disarticulation is more easily accomplished. Another advantage claimed for it is that only the terminal branches of the posterior circumflex artery in front are divided. The operation had best be described in Prof. Spence's words:—'The arm being slightly abducted, and the humerus rotated outwards, I cut down upon the head of the humerus immediately external to the coracoid process, and carry the incision down through the clavicular fibres of the deltoid and pectoralis major muscles till I reach the humeral attachment of the latter muscle, which I divide. I then, with a gentle curve, carry my incision across and fairly through the lower fibres of the deltoid towards, but not through, the posterior border of the axilla. Unless the textures be much torn, I next mark out the line of the lower part of the inner section by carrying an incision through the skin and fat only, from the point where my straight incision terminated, across the inside of the arm to meet the incision at the outer part. If the fibres of the deltoid have been thoroughly divided, the flap, together with the posterior circumflex artery, can be easily separated by the point of the finger from the bone and joint, and drawn upwards and backwards so as to expose the head and tuberosities, without further use of the knife. The tendinous insertions of the capsular muscles, the long head of the biceps, and the capsule are next divided by cutting directly on the bone. Disarticulation is then accomplished, and the limb removed by dividing the remaining soft parts on the axillary aspect. In cases where the limb is very muscular, I dissect the skin and fat from the deltoid at the lower part, and then divide the muscular fibres higher up by a second incision, so as to avoid redundancy of muscular tissue.'

The operation by *antero-posterior* flaps, the anterior one being made by transfixion and the posterior by cutting from within outwards, is the one the writer, as a rule,

prefers. It closely resembles one of the methods advocated by Dupuytren. It is comparatively easy of performance, results in a shapely stump, and admits of greater facilities for freely opening the articulation than the other methods. On the other hand, it is not suitable in cases of malignant tumours of the arm, or in cases where, owing to extensive fracture, the leverage of the arm is not available to raise the head of the bone from the glenoid cavity.

The operator standing at the side of the patient, and the arm being raised and abducted, the point of a catlin is entered immediately below the posterior border and at the greatest prominence of the acromion, and the instrument, carried across the outer and anterior aspect of the head of the humerus, is made to emerge below and internal to the coracoid process. A flap involving the entire of the deltoid muscle, down to its insertion, is then made. This is then held back, and the capsule opened. The tendon of the biceps and the muscles attached to the great tuberosity are next divided, and the arm being rotated outwards, the subscapularis is divided at its insertion; the head of the bone can then be easily displaced forwards and the knife passed behind it, and the postero-internal flap, somewhat shorter than the anterior one, cut from behind forwards and downwards. In doing this the surgeon, when operating on the right side, can compress the vessels with his left hand before they are divided. On the left side this can be done by an assistant. The axillary vessels, the posterior circumflex artery, and smaller muscular branches, will require ligatures.

Mr. C. Heath describes a somewhat similar operation; but he prefers cutting the anterior flap from without inwards, as it gives, according to him, a 'larger and more satisfactory flap.' This method is clearly preferable in cases where the operation has to be done in proximity to any form of malignant growth. He describes the operation as being done by grasping the limb with his left hand, and bringing it across the chest; and he then 'enters the point of an amputation knife at the most prominent point or angle of the acromion process. With a sawing movement he marks out a flap of skin and deltoid muscle, taking nearly the entire muscle down to its insertion, and bringing the incision up to the coracoid process, at the same time drawing the arm away from the side. An assistant grasping the flap draws it up so as to expose the shoulder-joint, which is to be opened by one semicircular sweep of the knife laid on

close to the anatomical neck of the humerus, the bone being rotated by the left hand of the operator so as to bring the several parts of the capsule into view successively. The tendon of the biceps is divided with the capsule, and the head of the bone is then readily dislocated, so as to allow the blade of the knife to be passed behind it to form an inner flap.'

In controlling hæmorrhage during the performance of this amputation much assistance will be derived from compression of the subclavian artery against the first rib, which can be done by an assistant, either by means of digital or instrumental pressure.

Other modes of performing this operation might be mentioned: for example, the single square-shaped flap method of La Faye, the modification of it by Richeraud, who added an internal or inferior flap; the anterior semicircular flap method made by transfexion of Dupuytren; the antero-posterior flap method as performed by Desault and Lisfranc, as well as many others; but the procedures to which the writer has already directed attention appear to him to be sufficient to meet the cases requiring scapulo-humeral disarticulation.

WILLIAM STOKES.

SHOULDER-JOINT, Diseases of the. A notable feature of the shoulder-joint is the very free movement which it allows in every direction; and one of the earliest and most valuable signs of disease of the articulation is an impairment of this free mobility.

The joint is best examined by standing behind the patient, and, while the scapula is firmly grasped near its neck and thus fixed by one hand, the lower end of the humerus is held by the other hand and can be moved in various directions. In the natural condition, this can be done without movement of the scapula upon the ribs, unless the arm be raised beyond a right angle with the trunk; but if the joint be inflamed, very little movement of the humerus, especially in the direction of raising the elbow, causes a corresponding alteration of the position of the scapula. Moreover, if the outline of the joint is carefully scanned both in front and from behind, and compared with the sound side, swelling may be detected by the alteration of shape and diminished distinctness of the surface-markings.

The shoulder is liable to all those forms of inflammatory disease, both acute and chronic, which are common to the articulations; but is much less frequently affected

than the other joints of corresponding size and importance.

Acute synovitis may be of traumatic, rheumatic, or pyæmic origin. There are the usual symptoms of swelling, heat, and pain, together with the restriction of movement above alluded to.

Rest, by bandaging the arm to the side, leeching, and the application of cold, are the appropriate remedies, and with the use of these the simpler forms of inflammation usually subside.

Pyæmic synovitis, which is not very uncommon in the shoulder, usually leads, however, to early suppuration. Matter points most commonly at the inner side of the deltoid, but may burrow along the intermuscular planes in other directions. Suppuration of this joint may also have its origin in an epiphysitis, or in an acute articular osteitis of the upper end of the humerus. It is a not uncommon seat of the syphilitic form of epiphysitis met with in young infants.

Suppuration here, as in other joints, calls for free incision and drainage; and, even when the destruction of the articular surfaces leads to extensive adhesions, the limb may be very useful, owing to the compensatory mobility of the scapula.

Chronic synovitis and pulpy degeneration must be treated by rest, counter-irritation, and attention to the constitutional condition in which it has its origin. Should the disease progress to ulceration of the cartilages, ankylosis may be regarded as a not unfavourable result. Slight adhesions, occurring without much destruction of the joint-surfaces, may be ruptured and good movement obtained; but if the adhesions or the diseased area are extensive, it is very difficult to prevent the recurrence of ankylosis, owing to movement taking place, involuntarily, rather by means of the scapula than at the shoulder-joint. In the scrofulous and other cases associated with great synovial thickening, the disease is apt to be slowly progressive and attended with troublesome suppuration; and in these, if the health is deteriorating, it is better to excise the head of the humerus, an operation which gives free access to the joint and allows of the removal of the diseased membrane, and which generally leaves a very useful limb.

The joint is a rather favourite seat of *osteo-arthritis*, recognisable by the usual symptoms of aching pain, crepitation, and impaired movement, alteration in the shape of the joint-surfaces, and fraying of the tendons which play over them. This disease,

occurring usually in the elderly whose tissues are degenerating, admits only of palliation, the most useful measures being friction, warmth, and aids to nutrition, such as cod-liver oil.

It may be well to mention here that the bursa beneath the deltoid is liable to both acute and chronic inflammation, giving rise to symptoms somewhat simulating those of disease of the shoulder-joint, but to be distinguished from it, chiefly, by the localisation of the swelling and pain, and the mobility of the humerus on the scapula.

J. WARRINGTON HAWARD.

SHOULDER-JOINT, Dislocations of the.—Dislocations of the upper extremity of the humerus are very frequent, owing to the shallow glenoid cavity, the loose capsule of the joint, and the exposed situation of the bone. The shoulder-joint is, indeed, far more frequently dislocated than any other joint in the body. The displacement is usually occasioned by a fall on the shoulder, sometimes by a fall on the elbow or hand, and, in rare instances, by such accidents as a jump from a height into water with the arms extended, falling through a trap-door, catching hold of a ladder to prevent falling, or a direct blow delivered on the upper end of the humerus. It has also been occasioned by muscular action. There are four regular dislocations of the shoulder-joint named from the position in which the head of the humerus is found—viz. (1) *subcoracoid*, which is by far the most common; (2) *subglenoid*, the next in frequency; (3) *subspinous*, which is uncommon; and (4) *subclavicular*, which is very rare. Besides these, certain anomalous dislocations have been described—viz. the *supracoracoid*, when the coracoid process has been broken and the head of the bone lies upon its base, and the *luxatio erecta*, a variety of the subglenoid. Dislocations of the shoulder are very uncommon under the age of fifteen, and much more frequent in males than in females, the proportion being about five to one.

Signs common to all forms.—There are certain signs of dislocation at the shoulder-joint which are common to all forms. These are—the angular appearance of the shoulder and depression beneath the acromion; the projection of the elbow from the side; the limitation of both voluntary and passive movements; the increased vertical measurement when a tape is carried through the axilla and over the shoulder (Callaway's test); inability to bring the elbow to the side when the hand is directed to the oppo-

site shoulder (Dugas's test); a ruler applied to the dislocated humerus may be made to touch the acromion and external condyle at the same time (Hamilton's test); finally, the rounded head of the humerus will be detected lying in some abnormal position.

THE SUBCORACOID.—This variety, which includes many cases that were described formerly as dislocations into the axilla, and some that were regarded as dislocations forward beneath the clavicle, has been proved, both by pathological demonstration and clinical observation, to be the most common form of displacement at the shoulder. It comprises both the intracoracoid and subcoracoid varieties of Malgaigne.

The *symptoms* which distinguish it are as follows:—The angular appearance of the shoulder is well marked; the elbow projects from the side, and is directed slightly backwards; the pectoral fold is widened and somewhat prominent; the head of the bone can be felt from the axilla and beneath the coracoid process, and its position can be made more evident in the axilla by raising the elbow; there is great pain from pressure on the nerves, and, usually, neither lengthening nor shortening, but the measurement from the tip of the acromion to the external condyle may vary to the extent of half an inch in either direction. Malgaigne described as subcoracoid only those in which the head of the humerus lay on the anterior edge of the glenoid cavity, and all those in which half or two-thirds of the head of the humerus lay to the inner side of the coracoid process he termed intracoracoid. The head of the humerus lies on the venter of the scapula beneath the subscapularis muscle. A *partial dislocation* in this direction was described by Cooper and Malgaigne, the head of the bone being supposed to partially escape on the edge of the glenoid cavity, without rupture or with slight tearing of the capsule. In Soden's case, believed to be of this nature, the escape of the biceps tendon from its groove was found to be the cause of the pain, fixation, and deformity, and in other cases this tendon has been found ruptured. In a case reported by Eve, in 1880, classed by him as complete, the capsule was found to have been lifted up with the periosteum from the front of the scapula, and a mark on the cartilage at the back of the head indicated the spot where this had lodged on the margin of the glenoid cavity.

THE SUBGLENOID variety comes next in point of frequency to the subcoracoid, with which it presents many points of similarity. The angular appearance of the

shoulder is more strongly marked than in that form, and the deltoid is rendered very tense. The elbow projects farther from the side, and the depression beneath the acromion is more evident, and is equally perceptible both in front of and behind the joint. There is lengthening of about an inch, and the fingers, placed in the axilla, readily detect the head of the humerus, which is lodged on the margin of the scapula between the long head of the triceps and the subscapularis. Lengthening is often apparent rather than real; the external condyle being approximated to the acromion by the abduction and loss of rotundity at the shoulder. The pectoral fold is much widened, but less prominent than in the subcoracoid variety, and, on pressure being made, an interval will be detected between the head of the bone and the coracoid process. Pain and numbness are felt from stretching of, and pressure on, the axillary nerves. This form of dislocation, if left unreduced, is liable to become converted into the subcoracoid, partly as the result of muscular action and partly from attempts to bring the elbow nearer to the side.

THE SUBSPINOUS is an uncommon form of dislocation, of which the writer has seen but two instances. It includes both the subacromial and subspinous varieties of Malgaigne. In stout subjects it is more liable to be overlooked than any other form, but in thin persons it is easily detected. The angular appearance of the shoulder, though present, is less marked than in any of the other varieties. The elbow is directed forwards and outwards, but not far from the chest-wall. There is usually no alteration in the length of the arm. The head of the bone may be felt in the subspinous fossa, where it lies below the acromion or spine and beneath the infraspinatus muscle. The anterior part of the shoulder is depressed, and the coracoid process is abnormally distinct. The subscapularis muscle is liable to be detached from its tuberosity by the force which produces the dislocation, and the infraspinatus is damaged by the head beneath it.

THE SUBCLAVICULAR is the rarest of the four regular dislocations of the shoulder-joint. In this form, the head of the bone is driven forwards past the coracoid process, and lies internal to it beneath the clavicle. The arm lies close to the chest-wall, and the elbow is directed outwards and backwards. The head of the bone is easily felt in its new position, and sometimes it becomes subcutaneous between the pectoralis major and deltoid. There is usually shorten-

ing of about an inch. The shaft of the humerus, but not the head, can be felt in the axilla, and the back of the shoulder is particularly flattened.

ANOMALOUS DISLOCATIONS.—*The Supra-coracoid*.—Malgaigne first described, under this term, the case of a man, aged sixty-eight, who fell from a load of faggots upon his shoulder and arm. The head projected upwards and forwards, lying on the coraco-acromial ligament, corresponding externally to the inner edge of the acromion and internally covering the coracoid process, whilst the deltoid was much thinned over it. Reduction, apparently not quite complete, was accomplished when seen two and a half months after the accident, by raising the elbow and pressing on the head. Holmes has since published an account of a dissection of a case in which the head had passed through the deltoid, had broken the coracoid process, and lay upon the stump.

The luxatio erecta is a curious and interesting variety of the subglenoid. Two cases have been described by Hulke and one by Cleland. The peculiarity of the dislocation is that the arm is raised and fixed in that position, the hand being above the head. Cleland's case was caused by a fall when using crutches; one of Hulke's by a fall through a trap-door; the other occurred in a sailor as the result of a fall from aloft, the arm being caught in the rigging.

THE TREATMENT of dislocations of the shoulder is to replace them without delay either by *extension* or *rotation*, after which the arm should be fixed for a fortnight or three weeks (according to the amount of damage present), and then gentle passive motion be commenced, followed by frictions, and perhaps galvanism, to restore the activity of the muscles.

The methods of reduction by extension are applicable to all forms, whilst the methods by rotation, which have lately come rather more into favour, are supposed to require some modification for the different dislocations.

THE EXTENSION METHODS.—*Extension with heel in the axilla* is perhaps the most certain of all the various methods, and is carried out as follows. The patient lies on his back upon a couch, and the surgeon, having uncovered his right foot, if for the right shoulder, thrusts his heel (not sole) into the axilla. Seizing the forearm with both hands at the wrist, he makes extension in the direction of the dislocated humerus, and then draws the arm across the patient's trunk. In this way the heel acts as a

fulcrum, by means of which the head of the humerus is forced outwards into its socket. If no anæsthetic is at hand, the aid of assistants may be required to overcome the resistance of the muscles. They may help by pulling on a jack-towel fixed by a clove-hitch to the arm above the elbow, and they should follow the motion inwards made by the surgeon.

Knee in the axilla (Astley Cooper's method).—The patient sits in a chair, and the surgeon, standing behind, places one foot on the edge of the chair, using the right knee for the left shoulder and *vice versâ*. The dislocated humerus is drawn over the surgeon's knee and forced downwards, by which movement the head of the bone is thrown out into its place. A somewhat similar plan, originally described by Hippocrates and revived by Morgan, is that of drawing the arm over the back of a chair. Slings the patient over the surgeon's shoulder by the dislocated arm, or over the step of a ladder, are both methods mentioned by Hippocrates. The weight of the patient's body would then be the extending force. Cooper mentions the case of a farmer, who learnt to reduce a frequently recurring dislocation by leaning over a gate and seizing the third or fourth bar on the other side. The fist, the forearm, and an iron knob have also been used in the axilla.

Upward extension (White's method).—A dislocation may be reduced by drawing the arm directly upwards, or upwards and backwards. The bone impinges first on the margin of the glenoid cavity, then against the acromion, and is thus partly raised and partly levered into place. If without assistance, the surgeon should stand behind the patient, and placing one hand on the shoulder should seize the wrist or elbow with the other, and draw the arm forcibly upwards and backwards. Another way, that of La Mothe, which gives more power, is to seat the patient on the floor; the surgeon then places one foot on the shoulder to make counter-extension, whilst with both hands he grasps the wrist and makes extension on the forearm. With two assistants, one should fix the shoulder and the other raise the arm; the surgeon is then free to manipulate the head of the bone into place. Upward extension is said to have been practised by Brunus as early as the thirteenth century.

Lateral extension may be made by placing the patient on a couch and fixing the trunk by a round towel, split to allow the arm to pass through. The arm may then be seized and extended at right angles

to the trunk. Another way suggested by Gordon is to lay the patient on his sound side, then to raise the dislocated arm at a right angle with one hand, whilst the other is used to press on the head of the bone; or, assistants may attempt to lift the patient by the arm, whilst the surgeon uses both his hands in manipulating the dislocated head of the humerus. A different method of employing lateral extension has somewhat recently been advocated by Kelly, and appears to be efficient if not elegant. The patient lies on his back at the edge of a couch, with his arm at right angles to the trunk. The surgeon presses his hip into the patient's axilla, and folding the arm around his pelvis holds it by the wrist against the unengaged side of his pelvis, then by rotating his body outwards he makes extension and pressure on the arm, which effect the reduction.

Lateral extension may be also made by pressing the foot against the patient's chest-wall for counter-extension, whilst pulling the arm directly outwards; or, as recommended by Nathan Smith, the counter-extension may be made from the opposite wrist.

When *pulleys* are used for unreduced dislocation (a method now seldom employed), extension is usually made in the same direction, the trunk of the patient being fixed by a split towel, and the girth for the pulleys being applied to the arm above the elbow. Skey's iron knob had branches to project in front and behind the axilla, by which the shoulder was fixed, so that the pulleys might act in the same direction as when employing the heel in the axilla.

THE ROTATION METHODS, like those by extension, are very ancient, but are constantly being re-invented with slight modifications by modern writers. Hippocrates describes reduction by flexing the elbow, drawing it back, and rotating the arm. It is somewhat curious to note that different authors advise rotation in opposite directions for the same dislocation, and their efforts appear to be followed by equal success. It is evident the mechanism of reduction must differ in the two cases. Most authors now agree in advising *rotation inwards* for the common forward dislocations and rotation outwards for the dorsal dislocation. Supposing the ordinary sub-coracoid dislocation to have occurred, the capsule will be ruptured at the anterior and lower part, whilst the upper and back part, with which the muscles of the great tuberosity are incorporated, will be very tense. Raising the arm and rotating it inwards

will cause the head to travel along the edge of the glenoid cavity and slip over as in reduction by rotation at the hip. Much assistance will be given by, at the same time, pressing the head outwards.

Kocher's method consists in flexing the forearm to a right angle, pressing the elbow towards the side, rotating the arm outwards till resistance is experienced, then raising the arm and rotating it inwards so that the hand drops over the opposite shoulder. *H. H. Smith's method* differs little from this and was published earlier. He directs that the forearm should be flexed and raised from the side; secondly, the humerus should be rotated upwards and outwards; and thirdly, this movement should be reversed, the humerus being rotated downwards and inwards, and the elbow carried to the side. Malgaigne also, following the Hippocratic method of rotating inwards, found that he could reduce nearly every subcoracoid case on the cadaver by this means.

Rotation outwards would seem to be a more recent practice, and to have commenced with Syme, whose method was to fix the acromion with one hand, then flex the forearm to a right angle and draw the elbow suddenly back, at the same time rotating the arm outwards. Professor Gunn, quite recently, has advised rotation outwards for the reduction of dislocation forwards, believing it right to relax the upper and back part of the capsule. He advises that an assistant should fix the shoulder, whilst the surgeon raises the arm to a horizontal position, carries it backwards, rotates it outwards, and draws it into position. For similar reasons, he advises that for subspinous dislocations the arm should be raised and rotated inwards.

The writer has found the following method very efficient. Standing behind the patient, he seizes the forearm just below the elbow, flexes it, raises the arm to a right angle and rotates it outwards; then, placing his disengaged fist in the axilla, he makes circumduction outwards and brings the elbow backwards and downwards to the side.

R. CLEMENT LUCAS.

SHOULDER-JOINT, Excision of the.
See JOINTS, Excision of.

SICK-ROOM, Management of the.—In this short article it is intended merely to sketch the duties of the surgeon and nurse as regards nursing surgical patients. The ward of a hospital is, or ought to be, so placed, apportioned, and hygienically arranged, that

it needs not the strict surveillance, in preparation and choice, that a room in a private house for the reception of the sick necessitates. When selecting a sick-room, or a room for operation and subsequent rest in a private house, look after the following points:—(1) Get a room on the top floor, or, at any rate, not lower than the second. (2) The room window should look southerly, light and sun-penetrated air being life itself to the patient. (3) Choose as quiet a room as possible. (4) A room of a good size is essential. By that is meant a room of such a size that it can be ventilated without draughts.

The Dimensions of a Room in cubic feet can be obtained by measuring, and multiplying the length by the breadth by the height, in feet. Supposing these were 15 by 10 by 7, the dimensions of such a room would be 1,050 in cubic feet. This is the smallest room any sick person should be put into. In a hospital, each bed should be allowed not less than 100 square feet of superficial area, and a cubic space of not less than 1,000 cubic feet.

To prepare a Room to receive a Patient.—Remove from the room every piece of furniture and clothing which can be dispensed with. Remove the carpets; empty the cupboards and chest of drawers; remove trunks, boxes from below the bed, &c., as these occupy space and so diminish the breathing air available for the patient. Dust the room out, not by flapping the dust from the mantelpiece on to the floor, but by carefully wiping the walls with a damp cloth, cleaning out the cupboards, pulling out each drawer and inverting it. When the dust has settled upon the floor, use a broom with a piece of moist flannel tied over it—this is the means to be employed always in a sick-room when the patient is *in* the room: in this way wiping and dusting are done without causing inconvenience or dampness. All dust from the sick-room floor is to be burned in the fire in the sick-room itself. Remember that below the bed, the chest of drawers, and the basin-stand dust lies unseen, but is not the less dangerous, and requires removal if the room is to be kept *sweet*. The floor is then washed, the metal bedstead wiped, the fire lit, the window opened widely, and the room left for a while. When the floor is dry, put the bedstead in its place—which ought to be against a partition wall, between the door and window, so as to be out of the air passing towards the fireplace from each of these.

The bedstead ought to be of metal, six feet three inches long, and three feet six

inches wide. Rheocline springs or a wire mattress may be used, and a hair mattress placed thereon; but in case of fractures these luxuries must be dispensed with, and fracture-boards used instead—i.e. deal boards, perforated with many holes, cut about one foot six inches in width, and in length equal to the breadth of the bed. Four such boards would ordinarily be required. A woven wire mattress with a thin hair mattress laid thereon is apt to be very cold. If two mattresses are used, the lower may be of straw; the straw must be burnt afterwards. If much discharge is expected, place a piece of macintosh over the mattress; instead, a blanket is used by some, but it is apt to act like a poultice and cause bed-sores.

Over these a sheet is now laid and tucked tightly beneath the upper mattress, if two are used. Do not wrap the bolster up in the under-sheet. It is the nurse's bounden duty to be continually pulling the under-sheet straight: this she cannot do without displacing the bolster and patient down the bed, if the bolster is wrapped up in the under-sheet. Complete the covering by an upper-sheet, blankets according to the season of the year, and a light chintz quilt. Avoid heavy counterpanes sweeping the floor on either side; exclude also a valance and curtains.

The Fire.—Place coals on the fire by the hand, to avoid noise. Coals are laid on a piece of canvas or paper on the floor; a large glove is hung, say, on the bell-pull above, and, slipping the hand into that, lift the coals. Dispense with a coal-scuttle and all fire-irons, except a poker. Should the room be full of smoke, cover the patient's head with the sheet, open the door and window wide; the room will be thereby cleared in a minute or two. Should the chimney require sweeping, have it swept, but previously put an extra blanket over the patient and a hot bottle in bed. It is the putting out the fire, especially in cold weather, wherein the danger lies—not in the smell of soot. The temperature of the room ought, in surgical cases, to be kept about 60° Fahr.; it should never be allowed to fall below 58°. When lung-troubles arise, the temperature ought to be kept between 65° and 70°. Hang the thermometer at the head of the bed close to the patient.

Ventilation.—In a room of 1,000 cubic feet, each person requires the air changed thrice per hour. Fresh air comes from the window, not from the door. The air is to be admitted in such a way that it has an upward direction as it enters. In the case

of an ordinary two-sash window, the plan recommended by Bird is the most simple—throw up the lower sash, and, placing a board along the gap made below, shut the lower sash down upon it. By this means air can only enter by the centre of the window, when it is sent upwards to the ceiling, where, meeting the hot air of the room, it is warmed and falls gently like spray from a fountain on the patient, and not as a torrent, which it would do were the top of the window opened. The board used may vary from one to six inches in depth, according to the season of the year.

To Wash a Patient in Bed.—Use tepid water, soap, and a flannel cloth. Place a towel on the pillow to protect it; wash the face, neck, and hair of a boy or man daily, wash a woman's hair once a week. Now, bring an arm from beneath the bedclothes, place a towel lengthwise below it to protect the sheets, and tuck the bedclothes round the shoulder; wash and dry the limb, and put it back beneath the clothes. Repeat this process with all the limbs *seriatim*. To wash the *front of the body* pull the night-dress up, and the bedclothes down; tuck a towel on either side of the body so as to protect the sheet; wash and dry the part exposed. To wash the *back*, turn the patient on one side, thus: standing on the floor, the nurse places one hand behind the patient's far-off shoulder, the other behind the far-off hip; if the patient is able to do so he ought to place his arms around the nurse's neck. The nurse can then turn the patient gently over upon the side; bare the back, tuck a towel below to catch the water, wash and dry the parts, and replace the patient. A patient is thus washed without more than a small part of the body being exposed at a time.

To make a Bed without moving the patient from the horizontal position.—Without removing the bedclothes, glide the patient to the edge of the bed next the fire. Place three or four bedroom chairs along that side of the bed, with the backs next the fire. On the chairs lay a bolster or pillows until this temporary couch is on a level with the mattress. The nurse, reaching over the backs of the chairs, now glides the patient, who can very rarely assist her, on to the improvised bed, where, covered over with blankets or a rug, the patient lies whilst the bed is being made. If the nurse even have two beds at her command, she will not, working by herself, find it so easy to move a patient on to the spare bed as by the method given, if the horizontal position is to be maintained. Do not use a sofa

or couch instead of the chairs. In making the bed, throw the blankets one by one, not all in a heap, over chairs, &c., in the room; or, if allowable, on the stair-rail outside the bedroom door. Turn the mattress, or hold it up, to let the air get at its under surface. When the bed is made up, retain around the patient the blanket in which he is enveloped, and glide him back into bed; remove the blanket around him when he is warm in bed.

To change Sheets.—Warm and 'air' the clean sheet; roll it up lengthwise; lay it thus rolled on one side, say the right, of the bed. Pull the soiled under-sheet from below the bolster, roll it up lengthwise, and unroll the clean sheet, up to the patient's right side. The nurse goes round to the left side of the bed, turns the patient on his left side, as directed for washing, and continues the process of rolling up and unrolling the sheets up to the patient's left side. Then, replacing the patient, he lies on the clean sheet, and the two appearing at his left side, the soiled is removed and the clean one tucked in. The sheet can also be changed by rolling or dragging it down from the top to the bottom of the bed. This is easily done when two are engaged in it, or when the patient can sit up in bed, but otherwise it is a rude proceeding. It is necessary, however, in a case of fractured leg, when the patient dare not be turned on the side.

Soiled Linen must be immediately removed from the sick room, placed in a jar outside the room, and, if non-infectious, sent to the laundry immediately; if infectious, boiling water is poured over it and a solution of 1 in 80 of carbolic acid, until the linen is covered and a strong odour of carbolic is smelt. Filthy *bandages* are to be burned immediately, it may be in the fire of the sick room. Bandages used for fixing splints may, after disinfection by boiling in soft soap and soda, be used again.

Utensils.—Cleanliness of the utensils in the room, whether in sickness or health, is a necessary axiom. Carbolic-acid solution (1 in 60) may be placed in the wash-hand-basin, in the bed-pan, in the chamber-utensil, the bleeding bowl, the dressing basin, &c., or carbolic powder may be sprinkled in them instead. This provides for the presence of a disinfectant in the room, which, by its decided odour, satisfactorily asserts its presence and activity. All slops must be removed at once, carried to the water-closet (or cesspool) and there emptied. The utensil should be there rinsed out, dried, have carbolic powder sprinkled

therein, and not be brought into the sick-room until it is wanted. Every pail and bed-pan used should be of white glazed earthenware, and have a tight-fitting lid. Place no utensil under the bed, not even when dried and disinfected; it cannot get sweet there—it must have a free circulation of air around it.

Feeding Patients.—It is needless to tell medical men to be careful about the time of feeding, the kind of food to be given, the method of its preparation, the needful time for changing it, &c. These are the first duties and requirements of practitioners; but how to administer the food few can tell the mother, sister, or wife of the patient—the nurse for the time being. When fluid foods, such as beef-tea and milk, are being given, attend to the following points:—A drinking cup may be useful, but see that its spout is wide, otherwise the patient gets tired of sipping the insipid fluids: he prefers a good mouthful, to get the feeding process over quickly. To give beef-tea, say at night, when the patient is asleep, have the beef-tea in a large warmed cup or jug, set on a small table by the bedside. The nurse then, without speaking or whispering—and this is the difficult thing to do—slips her left hand and forearm behind the patient's pillow and raises the head slightly. Then she can—if the bed is narrow, as it ought to be—reach with the other hand the basin and convey the food to the patient's mouth by a spoon. Use a large spoon—a tablespoon—and put little in it, otherwise the beef-tea will be spilt on the sheets, blankets, night-dress, or beard. A convalescent patient should be fed with dainty bits, under, rather than up to, his capacity and appetite.

The Nurse must wear a dress which causes no noise as she moves about, and which is pleasant to the patient to touch. She should have no pins about her, whereby to scratch the patient; she must be quiet and quick, resolute and gentle, cheerful, but expressionless in regard to untoward symptoms. She has to observe order and punctuality; and preserve not only cleanliness but sweetness in her apartment, in her patient, and in her person; but above all has she to cultivate gentleness and cheerfulness of behaviour towards her patient.

It is essential that a nurse's health be preserved by securing her rest in bed for at least six hours daily; and she ought, except in cases of great emergency, to get a daily walk for an hour. A nurse's meals should not be taken in the sick-room, where the patient must necessarily smell the cook-

ing, and thereby get disgusted for food himself; and the nurse ought to be allowed plenty of time for her meals, which should be served as punctually as those of the patient.

JAMES CANTLIE.

SIGAULT'S OPERATION. See SYM-PHYSIOTOMY.

SINUS.—A *sinus* is an unnatural suppurating canal which opens externally. When it communicates internally with one of the normal canals or cavities of the body, it is usually termed a *fistula*.

The primary *causes* are wounds, abscesses, or suppuration in deep-seated structures, such as bone or periosteum, or in cavities, such as joints, serous sacs, or the sheaths of tendons. The secondary causes are—

(1) *The presence of a foreign body*, introduced from without—e.g. a bullet or a piece of glass, or arising from inflammatory processes within—e.g. a sequestrum, the fang of a dead tooth, or a caseous gland. In this class may also be placed the discharges from ulcerating surfaces, such as those of a diseased joint. Of the same nature is the irritation set up by the escape of secretions or excretions through an unnatural opening, but the form of sinus which gives passage to such materials is described under the head of **FISTULA IN ANO**.

(2) *The size and position of the external aperture*.—If this be too small, or if it be some distance above the lowest part of the abscess-cavity, there will be an obstacle to the free discharge of pus, and the walls of the cavity will be unable to contract and coalesce. This may be due, in a wound, to the more rapid healing of the superficial tissues, and, in the case of an abscess or deep suppuration, to the difficulty of penetrating the strong fasciæ which lie beneath the integuments.

(3) *Want of rest*—e.g. where muscular movements prevent the walls of the cavity from uniting. Hilton, in his work *On Rest and Pain*, has given numerous instances of sinuses kept up by the contractions of the occipito-frontalis and other muscles. A frequent example is that form of sinus called a blind external fistula, in which the proximity of the sphincter ani prevents the healing of an anal abscess.

(4) *Want of apposition* of the sides of the cavity from which the pus is discharged. This is often exemplified in the slow repair of the sinuses which follow the removal of a sequestrum, or the opening of the pleural sac in empyema. It is probable

also that, after extensive destruction of the fatty tissue in the ischio-rectal fossa by suppuration, this may be one of the causes which prevent the closure of the resulting sinuses.

(5) *A feeble condition of health*.—This may be due to some inherent defect in the constitution, such as the scrofulous diathesis, in which the reparative lymph is so apt to undergo caseous changes; or it may be the result of loss of blood and prolonged suppuration, as in the debility which sometimes follows an amputation.

(6) *Local deficiency in reparative power*. The hard and evascular condition of the parts from the long continuance of a sinus may prevent its healing, even when the original cause—e.g. a sequestrum or foreign body—has been removed; or there may be some local influence, such as the enfeebled circulation from paralysis, or the congestion from a dependent position, which may tend to retard recovery.

Condition of the Parts.—The orifice of the sinus may vary in size from a hardly visible puncture to a large ulcer. It is sometimes concealed by a thin scab; at other times, especially when the parts are vigorous and vascular, it is indicated by a prominent mass of florid granulations. Where it has existed for some time, if it lead to deep structures such as bone, there will be some depression of the adjacent skin, at the bottom of which the granulations projecting from the aperture of the sinus will be seen, like the button upon a chair-cushion. The course of a sinus may be straight or tortuous. Its calibre may be uniformly narrow, or it may be varied by wide dilatations. The walls of an old sinus will be hard, pale, and insensitive, and they will not bleed readily when irritated. Their interior is sometimes so smooth as to resemble mucous membrane. In more recent cases they are covered with soft, sensitive granulations, and bleed readily. The adjacent structures are infiltrated with more or less developed fibrinous deposit, or even with bone, as in a *cloaca*, which is the part of a sinus passing through ossifying periosteum. The pus which exudes from a sinus is usually thin and watery, and it frequently contains fatty or calcareous debris from the deeper parts.

The *treatment* of sinuses constitutes a large part of the practice of surgery, but it is only possible to mention here the principles upon which it rests, and a few of the methods by which they are applied.

After obtaining a history of their formation, and observing the condition of the

apertures and the adjacent parts, it is necessary to examine their direction and extent by means of a probe, which may be straight, or, if the passage should prove tortuous, it should be slightly bent near the extremity. In the case of multiple sinuses, it may be desirable to use an injection to ascertain whether they are all in communication with one another. The presence of any hard foreign body or sequestrum will usually be easy to recognise, and at the same time an opinion may be formed as to the firmness with which it is fixed in the tissues. By an appropriate operation such a body may be removed, and the sinuses will usually heal up at once. If the opening be small, or not sufficiently dependent, it will be necessary to increase its size or to make a fresh opening in a more favourable position. Where this is not possible, as in the case of an iliac abscess penetrating deeply into the pelvis, the same end may be obtained by other means, such as keeping the patient lying in the prone position. An india-rubber drainage-tube should also be introduced, to ensure that there shall be no obstruction to the emptying of the abscess-cavity.

When want of rest or apposition is a hindrance to recovery, the parts may be kept quiet and in contact by the pressure of carefully applied compresses or strapping. If the sinuses are in the lower extremity, the patient should be kept in bed, and some form of splint or plaster of Paris apparatus may be necessary to ensure perfect rest. In other cases, the division of an adjacent muscle or tendon may be called for. The closure of the pleural cavity in empyema has sometimes been facilitated by the removal of portions of the ribs. Where the debility of the patient is the cause of delay, nourishing diet, cod-liver oil, iron or quinine, and a moderate allowance of stimulants will be required, and a change to the country or the seaside will be beneficial. The local weakness which prevents healthy repair may be combated by stimulating injections of iodoform dissolved in ether, or of sulphate of zinc lotion (five grains to the ounce of water).

In many cases, however, these methods will fail, especially when long-standing disease has induced a callous condition of the granulations. It will then be necessary to carefully slit up and explore the sinuses. This should generally be done under an anæsthetic, as to do it thoroughly necessitates often a tedious and painful operation. At the same time we should search for and remove any material which may be

keeping up the discharge. Thus, all caseous masses of gland-tissue and the carious surfaces of bones should be scooped out, and the degenerated granulation-tissue should be scraped from the interior of the sinuses; the thin, livid, undermined skin around their orifices should also be clipped off with the scissors. A large wound will thus be formed, which should be stuffed with lint or carbolic gauze, to prevent the primary union of the divided parts. In a few days, a granulating surface will be developed, and cicatrization will usually proceed rapidly, for the extensive margin of healthy skin will aid materially the process of repair. In some cases it may be expedient to make use of the elastic ligature for the division of the soft parts covering a sinus, so as to avoid all risk of hæmorrhage.

N. DAVIES-COLLEY.

SKIN-DISEASES.—During the last half-century great progress has been made in the scientific study of skin-diseases. This has not been confined to any one country, but has extended over the greater part of Europe and North America, and at the present time there is a general agreement amongst dermatologists on all the more important points connected with the subject. It is only necessary to look over the leading text-books in use in England, Germany, and America to see how close this agreement is. French literature does not follow in exactly the same path, but the differences, even there, are not many or important. This general agreement has led to the adoption of a uniform system of nomenclature, which until lately was almost impossible. This system has no doubt grown up gradually from the time of Willan, but has been much modified and improved by recent writers and observers. The process of improvement will continue, but the field for change has been greatly narrowed. The nomenclature lately published by the London College of Physicians fairly represents the one in general use, though some of the very rare forms of disease have been wisely omitted. Another fact of practical importance, which recent observations have tended to establish is, that skin-diseases cannot be looked upon as mere eruptions, but must be regarded, with few exceptions, as definite diseases, which do not change from one disease into another because there is a change in the form of the eruption, nor have they more tendency to become mixed than is the case with other diseases. Lastly, a knowledge of their morbid anatomy is almost entirely the result of recent

observations. The classification of skin-diseases, though interesting as an exercise or study, is of very little practical value. The following list is chiefly intended as a key for facilitating reference, and does not pretend to strict scientific accuracy in grouping.

Skin-diseases may be divided into three groups:—

I. Eruptions of an inflammatory character.

II. Diseases of nutrition unattended with inflammation.

III. Morbid growths of the skin.

The first of these includes all *eruptions* properly so called, and therefore forms a large group, which, for convenience, may be divided into two sub-groups:—A. Moist eruptions; B. Dry eruptions. The other groups, being smaller, require no subdivision.

The three *chief* groups of skin-diseases are quite legitimate divisions; but the subdivision of Group I. is simply a matter of convenience for purposes of diagnosis. Group I. comprises the skin-diseases attended with *inflammatory* eruptions. The degree of inflammation varies much, not only in different diseases, but even in varieties of the same disease; its presence, however, forms a bond of union, and, as a consequence, all eruptions belonging to this group are more or less associated with subjective sensations of pain, burning, or itching—a fact which is of some diagnostic value.

If, then, the reader has before him a moist eruption, and is in doubt as to its nature, he should first refer to Sub-group A, and having looked down the list until he comes to the disease which seems most nearly to correspond, he should then refer to the detailed account of the disease given in the body of this work. If the eruption is a dry one, he should refer in the same way to Sub-group B.

The moist eruptions which make up Sub-group A are the following:—Eczema, erythema with vesicles (i.e. hydroa), herpes, hyperidrosis, impetigo, pemphigus, phthiriasis, prurigo, scabies, syphilides (moist), zoster. The distinctive diagnostic features of each disease are given below in the following order:—(1) Character of the eruption; (2) subjective sensations; (3) characteristic (but not the only) regions affected.

1. *Eczema*.—Redness and swelling, with eruption of vesicles; surface denuded of epidermis, discharging gummy fluid; pain and itching; flexor surfaces and scalp; symmetrical.

2. *Erythema with Vesicles* (Hydroa).—Wheal-like spots of erythema with central vesicle or small bleb; itching and pain; backs of hands, forearms, lower lip and mouth; symmetrical.

3. *Herpes* (H. catarrhal.).—Discrete vesicles in small groups on red skin; not itching, pain slight; lips and prepuce; lasts about a week.

4. *Hyperidrosis* (including Bromidrosis).—The excessive sweating leads to a maceration of cuticle and artificial eczema; hands and feet.

5. *Impetigo* (Impetigo Contagiosa).—Vesico-pustular; thick, discrete, yellowish scabs, covering superficial sores; occiput, corners of mouth and nose; unsymmetrical; easily inoculated by finger-nails; lymphatic glands in neighbourhood enlarge quickly.

6. *Pemphigus*.—Crops of large blebs; pain and itching; skin generally and mucous membrane of bowels; constitutional symptoms severe; fatal in old people.

7. *Phthiriasis*.—Papules, excoriations and bleeding points from scratching; itching intense without pain; parts covered by clothes, especially back.

8. *Prurigo*.—Large papules mixed with an eruption of eczema, pigmentation and enlarged lymphatic glands; itching intense; extensor surfaces, especially lower limbs; symmetrical; begins in early life; very chronic.

9. *Scabies*.—Papules and vesicles discrete, with marks like pin-scratches; itching severe at night, without pain; flexor surface of wrist and between the fingers, lower part of abdomen and buttocks, also feet in infants.

10. *Syphilides* (Moist).—These simulate ordinary skin-diseases, such as eczema or impetigo, but are not common forms of syphilitic eruption, and are always associated with other symptoms of syphilis. See SYPHILIS.

11. *Zoster* (Herpes Zoster).—Large discrete vesicles in groups on red base; unsymmetrical; neuralgic pains before and after eruption; follows course of intercostal or other nerves; duration of eruption about a fortnight.

The dry eruptions (pimpley or scaly) which make up Sub-group B are the following:—Acne, acne rosacea, eczema (dry), erythema (nodosum and papulatum), lichen, psoriasis, steatorrhœa, sycosis, syphilides, urticaria.

1. *Acne*.—Pimples in young adults; not itching, slight pain; face and back; very chronic.

2. *Acne Rosacea*.—Red patches and pimples in middle-aged women; sensations of burning; face only; symmetrical.

3. *Eczema* (Dry).—Red, slightly scaly patches; great itching, no pain; flexor surfaces.

4. *Erythema* (Nodosum).—Raised, oval, red, bruise-like patches, painful and tender when touched; not itching; symmetrical; front of the legs; often associated with rheumatic pains. E. papulatum, much smaller spots affecting backs of hands and forearms.

5. *Lichen Planus*.—Large, raised, dark red, flat-topped, shining papules, leaving brown pigmentation; itching intense; flexor surface of wrist and front of forearm; symmetrical.

6. *Psoriasis*.—Raised patches covered with silvery white scales, healing first in centre; no pain; itching very slight in the young, often severe in the middle-aged; extensor surfaces of limbs, especially elbows and knees; symmetrical; very chronic and recurrent.

7. *Steatorrhœa* (Seborrhœa).—Greasy, scaly eruption; itching; scalp and eyebrows; partial loss of hair; often called pityriasis capitis.

8. *Sycosis*.—Red patches and acne-like pimples, with a hair passing through each; confined to the hairy parts of the face in males; very chronic. In this disease there is sometimes slight exudation from the hair-follicles. This, however, is not an essential feature, and the general absence of it is one of the distinctions between sycosis and pustular eczema of the hairy parts of the face.

9. *Syphilides* (dry eruptions) resemble the scaly and papular non-syphilitic eruptions, but are more mixed in character (polymorphic), with little or no itching and more pigmentation; they are associated with other symptoms of syphilis. See SYPHILIS.

10. *Urticaria* (Nettlerash).—Wheals and red raised patches; stinging sensation and intense itching.

II. DISEASES OF NUTRITION. — These are non-inflammatory, and are therefore free from those subjective sensations which are chiefly due to inflammation, such as pain, burning, and itching. This serves as a rough and ready distinction from the diseases of Group I. The only exception to this rule is tinea tonsurans (ringworm), which is often associated with very slight inflammation and itching, but the vegetable parasite interferes, in such a marked degree, with the nutrition and growth of the hair,

that this forms a much more distinctive character of the disease than the slight and almost accidental inflammation set up. The following are the diseases which belong to this group: *Alopœcia areata*, *chloasma*, *favus*, *ichthyosis*, *keratosis pilaris*, *leucoderma*, *lichen scrofulosus*, *striæ atrophicæ*, *tinea tonsurans*, *tinea versicolor*.

The distinctive diagnostic characters of each are given below.

1. *Alopœcia Areata*.—Smooth, roundish, bald patches surrounded by luxuriant hair; scalp, especially occiput and hairy parts of the face; hair falls rapidly with atrophied roots.

2. *Chloasma*.—Yellowish-brown pigment-patches; forehead and neck.

3. *Favus*.—Cupped, sulphur-coloured crusts and dry scaly patches; scalp; almost unknown in England; parasitic.

4. *Ichthyosis*.—A dry and scaly condition of skin, which has a dirty appearance; the cuticle is apt to crack, so as to form small lozenge-shaped plates. Body generally, but most marked about the knees and ankles; the disease is congenital, but shows little during infancy.

5. *Keratosis Pilaris* (*Lichen Pilaris*).—Papules with a hair passing through each; resembles exaggerated persistent 'goose skin'; outer surface of limbs, especially upper arms; symmetrical.

6. *Leucoderma*.—White patches of skin, surrounded by healthy skin often browner than usual.

7. *Lichen Scrofulosus*.—More or less rounded patches of minute pale pimples; no itching. Trunk, scrofulous children.

8. *Striæ Atrophicæ* (*Linear Atrophy*).—Glistening bluish-white stripes, resembling those met with in the abdomen of women shortly after parturition.

9. *Tinea Tonsurans* (Ringworm).—Roundish, scurfy, partially bald patches, with short, stumpy, broken hairs; slight itching; scalp; almost confined to children under sixteen years of age; parasitic.

10. *Tinea* or *Pityriasis Versicolor*.—Yellowish patches with a tendency to symmetry, almost confined to the trunk. Met with in adults who perspire freely; parasitic.

III. MORBID GROWTHS. — This group includes hypertrophic as well as other growths of the skin. As a rule, growths of the skin compared with eruptions are of slow development. Inflammatory eruptions occupy days or weeks, and morbid growths months or years in development. Morbid growths are firm solid structures, more or less raised above the surface of the

skin, and for the most part have an unsymmetrical distribution. The only exception to this is met with in lupus erythematosus, which cannot be described as a solid structure, and belongs at least as much to inflammatory eruptions as to morbid growths. The following diseases are included in this group: Acrochordon, fibroma, keloid, lupus vulgaris, lupus erythematosus, moles, molluscum contagiosum, nævus, rodent ulcer, scleroderma, syphilitic growths, warts, xanthelasma. The diagnostic characters of these diseases are given below.

1. *Acrochordon*.—Very small cylindrical or cordlike outgrowths; loose skin of neck.

2. *Fibroma*. (*Molluscum Fibrosum*). Small fibrous tumours; usual size from a pea to a filbert; often pedunculated, often congenital.

3. *Keloid*.—A fibrous growth which develops in scars; smooth and shining, and often vascular; pain or itching.

4. *Lupus Vulgaris*.—Reddish-brown tubercles and raised patches of new tissue, which have a strong tendency to ulcerate and form open sores; leaves scars. Face and mucous membrane of nose and mouth. Unsymmetrical; first appears between the ages of two and fifteen.

5. *Lupus Erythematosus*.—Red patches very little raised; often symmetrical; no ulceration, but leaves superficial scars; itching and burning; face, scalp, and ears. Does not appear before puberty.

6. *Moles*.—Congenital malformation of patches of skin, with more or less hypertrophy of the connective tissue, pigment, and hair.

7. *Molluscum Contagiosum*.—Small, round, umbilicated, translucent tumours; usual size from pin's-head to pea; face and neck; contagious.

8. *Nævus* is essentially a congenital vascular growth of the skin.

9. *Rodent Ulcer*.—Small translucent nodule, yellowish colour, streaked with minute vessels, of very slow development; ultimately ulcerates and spreads, destroying tissues. Face above the lower jaw, especially sides of nose. Rarely met with in those under thirty.

10. *Scleroderma* (*Morphœa*).—A fibrous growth in the form of patches of a pale yellowish-white and wax-like or ivory appearance, often with a pink areola of vessels; very little raised above the skin; pain and itching; often followed by atrophy of skin; very chronic.

11. *Syphilitic growths* are generally multiple, and develop more rapidly than

most other growths of the skin; have a strong tendency to ulcerate, and are associated with other symptoms of syphilis. See SYPHILIS.

12. *Warts*.—Small rounded raised growths, formed by hypertrophied papillæ, flat granular top; usual size, split pea. Hands in children, scalp in adults.

13. *Xanthelasma* (*Xanthoma*).—Sharply defined small bright yellow patches, resembling chamois leather; very slightly raised; upper eyelid and round the inner canthus; painless; seen chiefly in elderly people.

ROBERT LIVEING.

SKIN-GRAFTING. See GRAFTING.

SKULL, Deformities of the. See MENINGOCELE; RICKETS.

SKULL, Diseases of Bones of the. See CRANIOTABES.

SKULL, Fracture of the.—*Preliminary Observations*.—The anatomical relations of the skull and its coverings, relatively to the age of the patient, are important considerations in the determination of fractures of the cranium. The free movement of the head upon the spine, and the density and mobility of the scalp, tend to protect the skull by diminishing the impact of force from without. The construction of the vault in arch or dome shape increases its strength and power of resistance. The consistence and physical properties of the cranial bones, the intimacy of their union with one another, and the condition of the sutures vary greatly according to age. In infants, a complete fracture of the skull is rarely seen, on account of the elasticity of the unossified bones, and the gaps filled with membrane which exist between them. The consistence of the bones in young children enables them (practically) to bend rather than break, and indentations or bulges, with the convexity inwards, are formed. The same pliability is evinced in the gradual rectification of the deformity by the force of the brain's impulse. The relative consistence of the bones, in children and old people, has been aptly compared to sheet tin and earthenware. In adult life, and especially during the period of adolescence, the skull is still so fibrous as to permit of cuts being made into it without the production of fracture. Not only can instruments, and such materials as glass and earthenware, be driven into and sometimes through the skull by clean cuts, but by a sharp instrument portions may be cut or cleanly

scooped out. In early life, the lack of union between the bones is of value in distributing the pressure of a blow upon any given point, and the sutural membrane, at this period of considerable thickness, acts as a kind of buffer, which interrupts the force. In adult life this membrane disappears, and the sutures begin to be obliterated at about forty years of age. This complete union of the bones is first met with in the sagittal suture, and last in the squamous. The skulls of old people have lost much of their fibrous tissue, and have become more earthy and brittle.

The skull may be said to be made up of a series of arches, all resting upon and radiating from the basilar process. If these arches were of a definite and calculable thickness and consistence, and occurred with anything like uniformity in the human species, then, given the force applied to the cranium, it would be easy to estimate the exact position, the course, and the extent of the fracture. But as these factors are not constant, and as, besides, there are in the cranial bones a series of buttresses upon which the force is broken, interrupted, and distributed, it is impossible to arrive at a precise and accurate conclusion as to the course and extent of the fracture in the great majority of instances. While this is so, the nature of the injury and its mode of production assist in determining approximately the extent and character of the lesion. It is of use to know the usual manner in which force is transmitted through the various parts of the skull, as it explains how fractures are resisted in certain points, and shows how and where indirect fractures are likely to occur. It may be premised that a blow from a sharp instrument generally causes local lesion, while severe impact with a blunt body is apt to lead to a general injury.

When a blow is received on the vertex, the upper borders of the two parietals tend to be driven inwards, while their lower borders are forced outwards, this outward tendency being resisted by the squamous and the great wing of the sphenoid. It is supposed that the facial pain, often felt after such blows, may be explained by the force being transmitted from the squamous to the zygomatic arch, and so to the malar and frontal bones. A blow from a hard body may produce a fracture of the vertex, which may end there if the force is thereby exhausted; if not, a fracture of the base may arise from the head being driven down upon the summit of the spinal column. If the weight striking the vertex is of a yield-

ing material, then fracture at this part will not ensue, but fracture of the base alone from impact with the spinal column; or if the yielding force strikes the sides of the head, it may drive it against some obstacle outside the body, producing fracture at that part. The same is seen when a person falls from a height on the head: the entire weight of the trunk, with the superadded momentum, is concentrated round the condyles of the occipital bone, and the central fossa of the base of the skull is broken across. The force of a blow on the upper part of the frontal is communicated to the parietal bones. Force applied to the anterior aspect of the frontal may produce either direct fracture or fracture of the anterior compartment of the base. Blows on the occiput are very prone to fracture that bone; and this may also lead to longitudinal fracture of the posterior and middle fossæ. Injuries to the temporal region are followed by fractures of the middle fossa and petrous bone.

Fractures of the skull may be divided into those of the *vault* and those of the *base*; while under the former, the fissured, punctured, and depressed fractures are usually considered.

FRACTURES OF THE VAULT.—Fractures of the vault are generally caused by direct violence. They include most of the punctured fractures and incised wounds of the bone. They are commonly compound, and the brain-injury associated with them is, as a rule, local. They are frequently comminuted. Fissured fractures of the vault are generally associated with basal fractures, the one running into the other. Compound fractures are usually confined to the spot to which the force is applied, while simple fractures are most apt to spread.

Fissured Fracture.—As seen in the cadaver, a fissured fracture is easily discovered by its red outline, contrasting with the general white surface of the skull when denuded of periosteum. The fissure is red from the blood existing between the lips of the fractured bone. In this way fissured fractures contrast with the sutures of the skull, while the latter are further distinguishable by the irregularity of their interdigitating processes. This is best seen in children and young adults before synostosis sets in. It must be remembered that a fissure may actually pass through a portion of a suture, which would then present a red appearance from extravasated blood. As met with in practice, when uncomplicated by a scalp-wound, a fissured fracture cannot be discerned. The probability of its pre-

sence may be indicated by certain symptoms arising from the outpouring of blood into or from the cranial cavity. When there is a wound of the scalp exposing the fracture, it may be discovered by the eye, or felt by the finger-nail, or by means of a probe. When the wound is examined shortly after the accident, blood may be seen to ooze from the fracture, and to reappear as often as the wound is sponged out.

There are two sources of fallacy. The sutures may be mistaken for a fissured fracture. Their anatomical position, the irregularity of their outline, coupled with the fact that there is an absence of oozing of blood from between their edges, is sufficient to enable a distinction to be drawn. The other mistake is one which the writer knows has been frequently made, and is all the more liable to occur inasmuch as it has not been pointed out. It arises in scalp-wounds which have penetrated the periosteum, dividing it cleanly, but leaving one side of the periosteum closely adherent to the skull, while the other is raised so as to expose the bone. If the probe be used in such a case, it glides over the surface of the exposed bone until it meets with the sharply-cut edge of the periosteum, which is so thin, tense, and firmly adherent to the bone as to convey the impression that the probe has caught in a fissured fracture. This error may be avoided by digital examination, when the periosteum may be detected by raising a small portion on the finger-nail, as also by the sensation from the membrane itself. It must be remembered that when a scalp-wound does not also penetrate the periosteum, the fissured fracture will be difficult to make out, more especially as there is frequently a quantity of blood effused from the fissure between the periosteum and the fracture.

Punctured Fracture of the Skull.—When the skull has been punctured, the blow which inflicted the injury must have been delivered with considerable momentum, and by a linear or sharp-edged body. Under this heading there are many cases included which might with more propriety be described as wounds or cuts of the skull, inasmuch as the instrument or material with which it has come in contact has actually cut its way into the bone, and has not fissured or fractured it. Such punctures are frequently the result of violent blows with glass or earthenware; and when this is the case, a portion of these substances is often found embedded in the skull, and broken off so flush with its external table that it presents merely a rough-

ened edge, barely distinguishable by the probe, though more easily discerned by the finger. Knives seldom produce punctured fractures, and it is comparatively rare to find portions of them embedded in wounds of the skull, although this has been seen. When the fracture is linear, and there is nothing driven in between its edges, it may not be easily made out in the first instance. A scalp wound, in communication with a punctured fracture, does not always expose the fracture to view, the opening in such cases being more or less valvular. This arises from the mobility of the scalp over the skull. A lad who suffered from two punctured fractures of the skull, communicating with two valved wounds, was examined by a surgeon of considerable experience, who did not detect their presence until, at a second examination, he used his finger instead of the probe, when they were made out, and a small portion of bone removed from one of them. Punctured fractures are almost always compound, though the writer has seen one case in which there was a simple punctured fracture, the scalp being intact, but driven into the narrow osseous gap. In primitive forms of warfare, punctured fractures of the skull, arising from blows from arrow-heads, daggers, and from thrusts by spears, were much more common than they are at present.

Depressed Fractures of the Skull.—These fractures are generally easily recognised by the fact that, at a given spot, the normal contour of the skull is broken by an evident pitting or depression. When compound, this depression becomes very obvious and is often visible. As a rule, the periosteum has been torn and the bone exposed, but it occasionally happens that the periosteum remains intact, when the effusion of blood, issuing from between the fractured edges, strips and raises it from the skull until the depression is obliterated. Not only so, but, owing to the great tenseness of the over-stretched periosteum, a firm feeling is imparted to the finger, the nature of which, if not carefully examined into, might be misleading. This tension disappears in a few days with the shrinking of the blood-clot, when a more accurate diagnosis may be made. The depression may involve one or both tables of bone. When fracture of the outer table alone occurs, the depression is extremely slight, as the outer table can only be depressed to the extent of the depth of the diploë, except in the frontal region, where the outer table may penetrate the frontal sinuses. The inner layer of bone is occasionally fractured

alone, and this generally happens when the agent acts on the outside of the cranium, and the force is at the same time not severe.

When the force with which it acts is greater, and it impinges on the outside, both tables are generally broken, but the inner one is more depressed and more comminuted than the other. It is also found that, when the force acts from without, the inner table gives way first, and is fractured to a greater extent than the outer. When the force acts from within the cranium, the reverse is the case, the external giving way first, and being more severely fractured than the internal table. This occurs when bullets, after entering the skull at one place, strike the inner table at another point in their outward course. There are various reasons why the inner table gives way to a greater extent than the outer, on the application of external force. In the first place, the inner table is both thinner and more brittle than the outer. Secondly, the force as it travels through the diploë becomes distributed, and strikes the inner table over a wider area; and thirdly, the inner table forms a smaller curve than the outer one.

In children, depression of the bones of the skull is said to take place occasionally without fracture. There is generally an over-stretching of the osseous fibres, which is probably always associated with greater or less rupture, or *green-stick* fracture. It is true that the bones of infants are sufficiently elastic to bend without rupture of the fibres, but such indentations in the skull will not remain after the withdrawal of the bending force, the elasticity of the bone restoring the form. M. Péan has had several autopsies on the bodies of newly-born infants affected with this form of injury, and found that these *enfouissements* were always co-existent with fracture of the internal table, and sometimes of the outer one also. As to the *prognosis* of depressed fractures or indentations in the bones of infants, either of two results may follow. If the bone so bent be sufficiently elastic, it will, within a comparatively short period, assume its former contour. If, on the other hand, there has been a considerable rupture of the osseous fibres, especially of the inner table, and plastic infiltration quickly occurs, the deformity is apt to become fixed, and may remain permanently so, unless relieved by operation.

In relation to simple depressed fracture of the skull, it is well to bear in mind that an appearance closely resembling this condition is brought about in some contusions

of the soft parts. Where this occurs, there is a somewhat circular elevation of the scalp with a soft and sometimes depressed centre, which simulates a depression in the bone. This appearance is generally attributed to the effusion of blood, which coagulates round the circumference, while it remains fluid in the centre. The writer has had numerous opportunities of seeing this condition, both in the cadaver and on the living subject, and explains it as follows:—The central portion is the point which has been subjected to violent compression between the impinging body and the skull. In this part the cellular tissue has been broken up and scattered centrifugally, its elements, together with the neighbouring cellular tissue, causing a heaping up and condensation of the cellular tissue at the circumference, which soon becomes more dense by the infiltration of blood. The central portion of tissue on rare occasions remains adherent to the tendon, but it is usually separated from it by a quantity of fluid blood. There being no tissue intervening between the skin and the tendon, or, if any, it being in a highly rarefied condition, the centre has a peculiar soft yielding feeling, as if there was a complete hiatus in the osseous wall. This condition is differentiated from fracture with depression by the fact that the application of *firm* steady pressure, exercised by the finger, dispels the raised margin. The word '*firm*' is italicised, as in some cases it requires considerable steady pressure to dislodge a portion of the margin.

FRACTURES OF THE BASE.—Fractures of the base may arise from direct violence, as when a sharp body has been forced through the orbital or nasal roof, or through the pharynx into the middle fossa. The posterior fossa may be fractured by violence applied to the nape of the neck. Basal fractures are, however, most generally produced by indirect violence. A blow upon the nose, by driving in the ethmoid, may cause fracture of the anterior fossa. The cribriform plate of the ethmoid and the orbital plate of the frontal have been fractured by blows on the anterior aspect of the frontal. The writer has seen a case of fracture of the orbital plate of the frontal, which had been caused by a blow with the fist on the brow. This history was well authenticated, and there was no other injury of the patient's person which might have suggested a different conclusion. Falls upon the chin have been known to result in the driving of the condyles of the lower jaw through the glenoid fossæ into the interior of the skull. Fractures in the

occipital region have arisen from falls on the feet, knees, or buttocks, the force being transmitted through the vertebral column to the occipital condyles. Many basal fractures occur through the person falling while walking, the head coming into violent contact with the pavement. It used to be believed that many fractures of the base were due to *contrecoup*; this belief is now generally abandoned, though there are a few cases which may be explained in this way, such as a fall on the back of the head occasioning a fracture on the right side of the occiput and, at the same time, a fracture of the orbital plate of the frontal, on the left side. There is little doubt that the majority of linear fractures of the base are associated and continuous with fractures of the vault. It is well to bear in mind that fractures of the base may arise from what are considered to be comparatively trifling accidents, such as falls on the pavement.

In all cases, the head ought to be carefully examined for marks of violence. In the case of dark, dense-haired persons, bruises of the hairy scalp are easily overlooked, unless sought for in a good light. Where there is difficulty, and the case is a serious one, shaving of the head reveals the livid patch. In light-haired persons, no difficulty of this kind is experienced.

Fracture of the Anterior Fossa.—A fracture produced by a blow on the anterior portion of the frontal bone will probably be situated in the anterior fossa, though, if more severe, it may spread beyond it into the middle fossa. Blood sometimes escapes from the nose in fractures of the anterior fossa. This blood is derived from the meningeal vessels or torn mucous membrane of the roof of the nose. In one instance it came from the anterior portion of the superior longitudinal sinus, which had been torn; the *crista galli* having been driven upwards and backwards, while the cribriform plate of the ethmoid was crushed. If cerebro-spinal fluid escapes from the nose in a case of fracture of the base, it will show not only the mucous membrane on the roof of the nose, but also the brain-membranes, to have been ruptured.

In fractures of the anterior fossa, the blood may not escape externally, but may infiltrate the tissues surrounding the eyeball and also the conjunctiva of the eyelids. This appearance may be simulated by extra-cranial infiltrations. First, there is the common bruise of the eyelids, known popularly as a 'black eye,' and, secondly, there is the very common infiltration of the eyelids which follows wounds or bruises of the

brow. To attempt to differentiate between fractures of the skull and these two affections by the colour of the eyelids is altogether erroneous. The other signs generally advanced as diagnostic require to be carefully considered in relation to the supposed injury. The appearances differ in fracture according to its precise locality, and particularly whether the orbital plate of the frontal bone is implicated; or whether the fracture involves the orbital ridge of that bone. In the former, the reflection of the fibrous tissue from the periosteum to the tarsal cartilages is maintained intact, preventing the effusion of blood into the eyelids before, at least, it has passed into the conjunctiva; while in the latter it is ruptured, thereby permitting the blood to infiltrate the eyelids directly.

When fracture is confined to the orbital plate, there is observable, soon after the accident, a prominence of the affected eyeball. This is followed by the infiltration of blood into the conjunctiva, which takes place from behind, gradually implicating the anterior parts. Then the lower eyelid becomes puffy, much the same at first as in cedema, but deeply situated in the tissue a discoloration is discernible, which becomes more and more apparent until the colour is a pronounced shade, varying from a dark red to purple. The upper eyelid may escape the infiltration, or it may become involved at a later period, but it is seldom so distended or discoloured as the lower eyelid. In bruises of the eyelids—the ordinary 'black eye'—the eyelids swell with great rapidity, and are often so distended, shortly (two hours) after the injury, that they can with difficulty be opened. When forcibly opened, the conjunctiva is found to be frequently, though by no means always, free from infiltration. When it is devoid of discoloration at the beginning, it generally remains so throughout. In bruises situated on the brow above the orbit, the eyelids swell first, the upper sooner than the under, and the conjunctiva is seldom involved. On the other hand, when the fracture extends through the orbital ridge, the discoloration and swelling take place rapidly into the eyelids as well as into the conjunctiva; so that such a fracture could not be distinguished by the appearances of the eyelids from either of the foregoing. It is comparatively seldom that the strong orbital ridges give way. A surer sign of the fracture in this region is paralysis of some of the muscles of the eyeball, indicating injury to the orbital nerves.

In fractures of the anterior fossa, even when accompanied by severe injury to one

of the frontal lobes, there is frequently, at first, either very slight indications of brain-complication, or there may be absolutely none. In such cases, forty-eight to seventy-two hours have elapsed before serious symptoms have arisen, indicative of contusion or laceration in this region.

Fractures through the Middle Fossa.—Blows on the vertex and temporal regions and falls on the occiput are prone to produce fractures of the middle fossa.

The diagnosis of this injury is based on three points: a discharge of blood, an escape of cerebro-spinal fluid, and a facial paralysis. A flow of blood from a healthy ear may possibly arise from a rupture of the membrane of the tympanum, and in that case the bleeding would be derived from the vessels of the membrane of the tympanum. The blood which flows from an injury of this kind is generally bright in colour and very small in amount, and, owing to the contraction and retraction of the vessels, it ceases spontaneously. On the other hand, the blood which issues from the external auditory meatus in a case of fracture of the petrous portion of the temporal is generally dark-coloured, wells slowly and continuously for hours and sometimes for days or longer, during which its colour gradually becomes lighter, from the admixture of cerebro-spinal fluid with the stream. This blood comes from some of the larger vessels inside the cranium, and not infrequently from the lateral sinus. Subsequently, the discharge from the ear consists entirely of clear fluid, which often continues for days to stain the pillows. Before this cerebro-spinal fluid could come away, the tubular prolongation of the brain-membranes surrounding the seventh pair of nerves must have been torn, and the fracture must have passed through the internal auditory meatus. There must likewise have been a rupture of the membrane of the tympanum, and a communication between the internal ear and the tympanum.

Where there are wounds on the face, head, or neck, blood in considerable quantity may be found in one or other ear, and it then becomes necessary to determine whether it comes from the wounds or from the interior of the skull. The blood as it passes from the wounds to the ear may leave a track, which would be of value if it were not for the fact that blood, issuing from the interior of the skull and flowing from the ear, may leave a track of the same kind, the blood from the ear mingling with that of the wound. In any case of doubt, the ear ought to be wiped out with a piece of

lint in a pair of dressing-forceps. The wounds on the scalp or face should then be dressed, and the ear carefully watched for reaccumulation of blood. If this does take place, the fact that it comes from the interior of the ear will be established. There are instances in which the fracture of the petrous portion has occurred, accompanied by the rupture of the other parts as already described, with the exception that the membrane of the tympanum has not been torn. The flow of blood takes place from within, but, as it cannot escape from the external ear, it follows the course of the Eustachian tube and thereafter escapes from the mouth and nose. The blood may also be swallowed, and hæmatemesis may follow subsequently. Occasionally, even when the tympanic membrane has been ruptured, the blood finds its way through the Eustachian tube, as well as through the external ear; there is then bleeding from the mouth, nose, and one ear. In some cases of fractured base, infiltration is observed at the posterior aspects of the pharynx, and when the mucous membrane of the pharynx has been ruptured, persistent bleeding is apt to occur. From such a fracture, with rupture of the mucous membrane of the pharynx, there may also be a discharge of cerebro-spinal fluid. Whenever there is clear evidence of the escape of cerebro-spinal fluid, the diagnosis of fracture of the skull may be regarded as almost certain. If, in addition to the flow of blood at the beginning of the case, and the escape of cerebro-spinal fluid, there is loss of sensation and motion of the parts supplied by the fifth and seventh nerves, the diagnosis becomes complete.

The cerebral symptoms accompanying fractures of the base are very varied. At first there may be nothing wrong mentally, and in such cases it may be difficult to persuade the patient or his friends that he has sustained a serious injury. More often, there is confusion of thought and unsteadiness of gait. If the fracture be accompanied by considerable brain-pressure, there will be insensibility. In most cases there is insensibility, as an early if not an immediate feature in fracture of the base, though the insensibility be not necessarily indicative of pressure. Given an insensible person who has met with an injury, and who has bleeding from the ear, the presumption is that he suffers from fracture of the middle fossa of the base. The great majority of fractures of the base are of the middle fossa.

Fracture of the Posterior Region of the Skull.—There are few cases in

which there is fracture of the posterior, without also the middle fossa being implicated. When they do occur separately, their differential diagnosis is very difficult, except when there are local signs to guide one. Blood, extravasated over or in the neighbourhood of the mastoid and occipital regions and at the sides of the neck, is frequently seen some days after the posterior fossa has been fractured. Occasionally, there is also tenderness on pressure on the mastoid process. These signs are of special value, when the seat of external violence is at a distance from the parts into which the infiltration occurs. If the functions of the eighth and ninth nerves were specially involved, as evidenced by impairment in swallowing and in the movements of the tongue, a guide to the lesions in this region would be established. These indications are, however, generally lost in the insensibility which is apt to be present in traumatic cases affecting this region.

TREATMENT OF FRACTURE OF THE SKULL. As the gravity of fracture of the skull depends on the degree and the extent of the cerebral involvement, the treatment will naturally be directed, first, towards the prevention of cerebral complications; and, second, to their relief when they arise. As the latter are fully treated of under the headings of CONCUSSION, COMPRESSION, and ENCEPHALITIS, the former only are dealt with in this article.

The fractures which are most apt to be complicated by cerebral affections are the compound, the punctured, and the depressed. All compound fractures must be rendered aseptic and maintained so throughout. This is the surest way of preventing meningitis and encephalitis, as a septic state of the wound is the most frequent cause of these affections. To render the part aseptic, the hair should be shaven and the scalp thoroughly purified, first by soap and water, then by turpentine, for the removal of greasy matters, and finally by the application of an antiseptic solution. Drainage ought to be attended to, and an antiseptic dressing applied, which should be fixed in position by elastic webbing. Iodoform dusted round the circumference of the wound is a valuable aid in keeping the wound-secretion aseptic. A dressing of antiseptic gauze or sublimated wood-wool ought to be applied. In fracture of the middle fossa, with rupture of the membrane of the tympanum and the escape of blood and cerebro-spinal fluid, the same precautions ought to be adopted. An antiseptic powder, such as iodoform, may be put into the external ear, provided it does not

so completely occlude the orifice as to prevent the escape of discharge. All operations on the skull and its contents must likewise be conducted under rigid antiseptic precautions.

Regarding depressed fractures, all surgeons agree that the depressed bones ought to be elevated, when they produce symptoms of compression. But the same unanimity does not prevail concerning the treatment of depressed fractures, when unaccompanied by cerebral symptoms; most advising that they be left alone, while a few recommend their elevation. A considerable depression of bone is required to produce immediate and pronounced symptoms of compression, and there can be no doubt that a large number of cases of depressed fracture recover without elevation of the fragments. But there is reason to believe that, in not a few instances, although immediate recovery has taken place and the patient has been discharged from the hospital as cured, yet in the course of months certain cerebral changes become developed, as evinced by motor, sensory, or psychic phenomena; and in some, these affections become permanent or ultimately lead to a fatal issue. It may be alleged that such cases may have had brain-lesions independent of the depression of the bone; but of this there was no evidence, while the fact of the depression of the skull was clearly established. Besides, one never knows by the external appearances to what extent the inner table of the skull has been depressed, although it is safe to state that it is depressed to a greater extent than the outer table.

The chief reason against the elevation of the depressed bone lies in the fear of exciting inflammatory action in the membranes or in the brain itself. There was good ground for this fear so long as wounds were not kept aseptic; but with the means at present at the disposal of the surgeon it is no longer tenable, and what remains for the surgeon to make sure of is, that the depressed bone or spicula which may be driven through the membranes do not maintain compression or incite irritation, which may lead to inflammatory action of an acute or chronic character. Therefore, when there is marked depression of the skull involving both tables, it ought to be elevated, without waiting for the development of symptoms of compression or of irritation, provided the surgeon has the means of preserving the wound in an aseptic condition. Punctured fractures ought to be treated in the same way, as far as the

antiseptic precautions are concerned. They ought to be carefully explored and all loose fragments elevated.

The depressed portions of bone may be raised by means of an elevator placed under the extremity of one of the fragments. The instrument rests on the border of the sound skull as a fulcrum, while the elevator is used as a lever to lift the fragments outwards. There are many cases, however, in which the elevator cannot be used in this way at first, owing to the fact that there is no gap in the depressed bone into which the elevator may be passed. In such cases, an aperture requires to be made at the side of the depressed bone by means of a saw or a trephine. In using the latter, the central pin of the instrument ought to be placed on the sound skull and made to penetrate its substance sufficiently to steady the trephine, thus preventing slipping, and permitting the rotatory action of the circular saw to be maintained until it has made a sufficient sulcus for itself to enable it to run without the central pin, which should then be withdrawn. As the inner table is reached, great caution must be observed to prevent penetration of the membranes. This risk may be lessened by frequently inserting a probe into the grooves and removing the bone-débris produced by the saw, at the same time exploring the depth to which it has penetrated. When the sawing is completed, the elevator may then be brought into use and the disc removed. The aperture thus made will permit of the depressed bones being elevated.

After having elevated the portions of bone from a depressed fracture, instead of leaving the brain and its coverings exposed, the bones so removed should be carefully preserved under aseptic conditions until the completion of the operation, when they may be replaced in part at least, so as to form an osseous wall over the aperture. The writer has frequently adopted this practice with complete success.

In all fractures of the skull, the patient ought to be placed in bed in a quiet room, the head shaved, a brisk purge administered, and a low diet given. He ought to remain in bed for at least four weeks, and be kept under observation for months afterwards.

CONTUSION OF BONES OF SKULL.—Blows on the head may produce contusion of the skull, with or without the production of wounds, and they are sometimes followed by inflammatory action in the bone, which may induce hypertrophy, or may lead to caries or necrosis. In some instances, the periosteum and the dura mater may be

separated from the bone at the injured part, when necrosis of both tables may ensue. In others, the periosteum may alone be separated, and the external table may be driven into the diploë, resulting in a separation of the external table. In one instance, at least, a considerable portion of the internal table of the calvaria was found separated from contusion. In such cases, inflammatory action may take place in the diploë, and from thence the inner table is apt to be affected. There is danger of the inflammatory action spreading from the bone to the brain-membranes, or even inducing pyæmia through the infection of the veins of the diploë.

When the inflammation spreads to the membranes, the dura mater becomes separated from the bone by a layer of plastic effusion, or of pus. The bone, if denuded, becomes dry, and by-and-by discoloured. If the scalp remain intact over the contused bone, an cedematous condition of the soft tissues frequently takes place coincidentally with the purulent effusion into the diploë, or under the skull. Accompanying this condition there is persistent headache, frequently localised pain, corresponding to the seat of inflammatory action, and an increased temperature. In a few cases these symptoms set in early, but in the majority they occur from two to three weeks after the accident. When the inflammation spreads beyond the dura mater, involving the arachnoid, it no longer remains localised, but becomes diffused over the surface of the membranes; and if the inflammatory action be intense, the visceral layer, the pia mater, and the surface of the brain become implicated. Rigors, at this stage, are frequent, with occasional vomiting, drowsiness, coma, and paralysis.

These symptoms are prone to arise in contusions of the bone, complicated with wounds which are permitted to become septic; seldom do they set in under thoroughly aseptic conditions. When such symptoms do arise, the first thing to be attended to is the condition of the bone; and if it be dry or necrosed, it ought to be removed, thus giving exit to any inflammatory products which may exist between the dura mater and the skull. If the pus be under the dura mater, and especially if an abscess has formed, this membrane will not evince the cerebral pulsations and will probably bulge into the trephine-opening. If this is the case, the membrane should be opened, and the pus permitted to escape. *See* further under **ENCEPHALITIS AND MENINGITIS**.

WM. MACEWEN.

SLOUGH and SLOUGHING.—When gangrene occurs in the soft tissues, the dead portion is called a *sphacelus* or *slough*; whilst the gangrenous process by which the slough is produced, and the ulcerative process by which it is separated, are often spoken of as *sloughing*. Sloughing, therefore, is not a pathological process distinct from gangrene and ulceration, but a term conventionally applied to certain forms of these morbid processes. Thus when, after an amputation, from deficient blood-supply or other causes, portions of the flaps die and are cast off in the form of shreds or semi-solid masses, they are said to be sloughing. When a wound or ulcer takes on an acute inflammatory action, and rapidly enlarges by the death, in visible masses, of its edge or granulations, it is called a sloughing ulcer; whilst again, when under certain circumstances a portion of tissue—a tendon, for example, in the case of a whitlow—becomes gangrenous, the process of ulceration by which it is separated is spoken of as sloughing. But not every process of gangrene is so termed. Thus, when the whole foot dies in old persons, or gangrene rapidly spreads up a limb, the foot or limb is not said to slough, but to mortify, or to be in a state of gangrene; neither is the separation of such gangrenous masses, as a rule, designated sloughing. *See also* HOSPITAL GANGRENE; *Sloughing Ulcer* under ULCERS.

W. J. WALSHAM.

SLOUGHING PHAGEDÆNA. *See* HOSPITAL GANGRENE.

SMITH'S (NATHAN) ANTERIOR SPLINT for the lower limb is best made of two stout wires fixed together by transverse bars; the splint should reach from the lower part of the abdomen to the toes, and should be bent slightly opposite each of the three joints of the limb; the splint should be suspended over the limb, and the latter bandaged to it from the foot to the groin. It is a useful splint for treating wounds and compound fractures involving the posterior part of the limb.

SNUFFLES. *See* CONGENITAL SYPHILIS.

SPECTACLES. *See* ACCOMMODATION, Disorders of; CATARACT-GLASSES; REFRACTION, Errors of.

SPECULA are instruments employed to conduct the rays of light into some of the internal passages of the body, and also to separate the walls of those cavities so

that their entire surfaces may be successively brought under observation, either for the purposes of diagnosis or operation.

Bright daylight, when obtainable, affords sufficient illumination for most purposes; for the examination of the nasal cavities the light reflected from a white cloud serves admirably, if focussed on the diseased parts with a mirror. If the light be bad, or if it be difficult to obtain owing to the position of the patient, artificial illumination must be employed. For the examination of the middle ear, a strong artificial light should be reflected into the meatus with a mirror.

The specula here described are grouped according to the regions for which they are most employed.

VAGINAL SPECULA may be classed under four heads, according to their mode of action—viz. the tubular, the duckbill, the bivalve, and the three- or four-bladed dilating specula.

Tubular Specula.—The best known speculum of this shape is Fergusson's. It is made of silvered glass, coated externally with gum elastic. The diameter of the tube is the same throughout. The distal or uterine end is bevelled, so that one side—the anterior—is shorter than the other. The proximal end is trumpet-shaped. The great objection to Fergusson's speculum is its liability to break, but this may be obviated by substituting metal for the glass. Hall Davis's speculum differs from Fergusson's in being made of metal or celluloid, and in tapering slightly towards the uterine extremity. It is claimed for this instrument that it is easier to introduce, that it possesses more illuminating power, and is not so fragile as Fergusson's speculum. Tubular specula act by distending the vagina longitudinally, and pushing the uterus before it; they afford good illumination, but unless as large a size as possible be employed, the folds of a lax vagina often obstruct the view.

Duckbill Specula.—Sims's speculum is made of plated metal, and consists of two specula or blades of different sizes, united together by a handle, which may be either rigid, or hinged in the middle so as to allow of its being folded up to half the size. Each blade is hollowed on its anterior surface, and its end is turned upwards so as to resemble a duck's bill; the blades of the real Sims's speculum are set at right angles with the handle, but in some modifications of it (Bozeman, Battey), the blades are set at an acute angle with the handle. This speculum is employed with the patient in

the semiprone or in the lithotomy position, and its blade is meant to lie on the posterior wall of the vagina with its extremity behind the cervix of the uterus. If the anterior wall of the vagina is lax, it falls down and obstructs the view; to obviate this a loop of wire may be so hinged to the base of the speculum (Griffith's), that by depressing the external end of it the uterine one may be raised so as to support the vaginal wall.

The modification of Sims's speculum, known as Neugebauer's, is divided transversely in the handle but capable of being joined together again; the ends of each blade are, however, open and in a line with the general curve of the instrument, instead of being turned up or inverted like the duck-bill. The lesser blade can be fitted into the larger in such a way that a bivalve or tubular speculum is produced. The posterior blade should be introduced first, so that its extremity lies behind the cervix, and then the anterior one should be introduced with its borders turned to those of the other blade, and in such a way that they fit within them. When in position, the blades work on one another like a bivalve speculum, and, consequently, by approximating the handles the opposite ends of the specula become separated, and the deep part of the vagina dilated. Barnes's crescent speculum is a modification of the last-mentioned, in which each blade is crescent-shaped, and each extremity of the blades is like the uterine end of Neugebauer's instrument.

Bivalve Specula are composed of two blades hinged together so that they may be separated either in an antero-posterior or lateral direction. Bennett's, Barnes's, and Cusco's specula are instances of the first kind, and Ricord's of the second. Both Barnes's and Bennett's specula are tubular when closed, but as their uterine ends are not bevelled, a plug with a rounded end is used to facilitate their introduction; by means of a screw one of their blades can be raised or depressed. Cusco's instrument does away with the necessity for the plug, for it is composed of wide and almost flat blades which, when they are shut, fit accurately together, both along their borders and at their extremities. The blades may be plain or fenestrated. By means of the screw, which acts on both blades, the instrument may be opened. Cusco's speculum should be introduced with its blades looking laterally, but before it is pushed completely in, the instrument should be rotated so that they look antero-posteriorly. The blades of Ricord's speculum are hinged to-

gether at a little distance from their external extremities, and, by approximating the handles, the uterine ends of the blades may be separated laterally. Reeves's dilating speculum is a bivalve instrument, the blades of which open laterally; by means of screws and levers it is possible to separate the blades either at one or other of their extremities or along their entire length. Nott's speculum is a three-bladed instrument, but its principle of action is similar to Cusco's bivalve; instead of the single upper blade of the latter, Nott's speculum has two narrow blades.

Dilating Specula are three- or four-bladed instruments which distend the vagina both antero-posteriorly and laterally. Meadows's three-bladed instrument consists of a lower blade, which has a duck-bill shape, and of two narrow upper blades, which are bent at a right angle a little in front of the hinge by which they are attached to the lower blade; when the upper blades are separated from one another, they are also raised equally along their entire length. Meadows's four-bladed dilating speculum has an anterior and a posterior duckbill-shaped blade, and two narrow lateral blades; the latter are forced outwards when the former are opened by means of a Cusco's screw. Scanzoni's speculum consists of four stout metal rods with inverted extremities: when the blades are shut the instrument becomes a fenestrated tubular speculum, which is easy to introduce; by means of handles and screws all four blades can be separated.

RECTAL SPECULA.—Many of the vaginal specula are equally servicable for examining the rectum.

Fergusson's rectal speculum is made of silvered glass coated with gum elastic; it is a tubular instrument with a rounded end and a narrow opening on one side. Gowland's specula are made of plated metal, and further differ from Fergusson's in having a much wider opening along one side, in being open at the distal extremity, and in tapering slightly from the outer to the inner end. They are introduced with a plug. Hilton's speculum is made of metal, and resembles Fergusson's except that it tapers a little towards the distal end; it is provided with a plug and with a metal handle, which is fixed by a hinge to the proximal extremity. Bryant's speculum consists of two duckbill blades, each of which is attached to a separate handle; one blade fits into the other so as together to produce a tubular speculum with a closed end; after introduction the blades can be separated

after the fashion of a bivalve speculum. The two handles can be fixed together so as to produce a speculum very much like Sims's duckbill. Allingham's speculum is a four-bladed instrument, which, when the blades are closed, occupies very little room and is consequently easy to introduce; when the blades are opened, the whole circumference of the rectum can be seen at one view. Lane's speculum is a three-bladed instrument; the blades are much broader than those of Allingham's speculum. Hogan's speculum is composed of two metal rods, each of which is bent at an angle in the middle; one of the ends of each rod is fixed to the extremity of one of two levers, which can be separated by handles; the other end can be fixed into notches along the side of the levers. When the levers are approximated and the blades released from the notches above mentioned, the speculum becomes very small and can be easily introduced. By separating the levers the rectum becomes distended laterally, and by depressing the free ends of the bent bars and fixing them in one of the notches on the sides of the levers, the rectum becomes distended antero-posteriorly also. *See* ENDOSCOPE.

URETHRAL SPECULUM.—Bryant has introduced a small speculum and dilator made of box-wood or ivory, which he finds of great use when removing vascular growths from the female urethra. The speculum is a hollow conical instrument with a broad cleft along one side.

NASAL SPECULA.—For examination of the anterior portion of the nasal cavities Fränkel's speculum is one of the best; it consists of two skeleton blades hinged to a transverse bar, through which a screw works so as to act by means of levers on both blades. The blades of the instrument should be introduced closed into one nostril, and then separated sufficiently to afford a good view and to be self-retaining. The handle of the instrument hangs down over the lip, and is quite out of the way. The skeleton blades may be replaced by solid ones (Von Tröltsch), and the screw arrangement for separating the blades may be replaced by a loop of wire, which has sufficient elasticity to keep the blades apart (Goodwillie). Sliding ivory plates may be adapted to the fenestrated blades, so as to protect the nostril during the applications of the cautery. Thudichum's speculum consists of two flat blades of metal or bone united by a loop of wire, the elasticity of which keeps the blades well apart. Lennox Browne's speculum is an ivory cylinder

with a blunt end and an open upper surface; it is introduced by means of a plug.

Elsberg's speculum is composed of three blades, which are set at an angle of 90° or a little more with the handles. The two lateral blades are separated by approximating the handles, either quickly by the hand or more slowly by means of a screw. As this is done, the lower blade is depressed by means of two levers united to a rod connected with it and the handles of the instrument. Duplay's speculum is a very useful instrument for displaying the deeper parts of the nasal cavities; when closed, it has the shape of a hollow cone with flattened sides and a rounded apex; it is a bivalve instrument, and its blades can be separated by turning a screw. The inner blade is more flattened than the outer, and it is continued into the trumpet-shaped proximal end of the instrument. The outer blade is the one which is moved by turning the screw. Schuster's and Votolini's specula only differ from the last in the means adopted to separate the blades. The bivalve specula afford a good view of the deeper parts of the nasal cavities, but if it be desired to examine the posterior wall of the pharynx and the region of the Eustachian tube through the anterior nares, Zaufal's funnel should be used. It consists of a long hollow cylinder of polished metal with a funnel-shaped outer extremity.

AURAL SPECULA.—The best speculum for most purposes is Keene's; it is a hollow cone of plated metal with a short cylindrical extremity. Toynbee's and Wilde's specula taper gradually from a trumpet-shaped outer end to a small elliptical or circular inner one. Specula, of similar shapes to the three already mentioned, are made of vulcanite and are very useful when substances which would tarnish silver are being used. Kramer's speculum is a bivalvular instrument, whose blades are set at right angles to long handles, by means of which its blades may be separated. It is rather inconvenient, because one hand is required to hold the instrument. Woakes' speculum is a useful bivalvular instrument; its principle of action is the same as that of Duplay's nasal speculum; it is self-retaining.

EYE SPECULA are employed to separate the eyelids. They are made of wire, and have two blades, which are so formed that they fit securely on to the borders of the lids. When the blades are separated, the eyelids are opened widely. The blades may be separated by a contrivance similar to that employed by Fränkel for his nasal speculum,

or by the elasticity of a spiral twist of the wire which unites the blades. If the latter method be employed, the instrument should be provided with a stop-screw, by means of which the separation of the blades may be checked when they have opened the lids sufficiently. The handle of the instrument should be curved, so that it may rest just above the zygoma, and be out of the surgeon's way.

BILTON POLLARD.

SPERMATIC CORD, Diseases of the.

In this article only abscess and the solid tumours of the cord will be considered. The fluid tumours and varix of the cord are described under HYDROCELE; HÆMATOCELE; VARICOCELE.

ABSCCESS.—*Causes.*—Inflammation of the cord, running on to acute abscess, may be the result of injury, or complicate urethritis and epididymitis. In tubercular disease of the testicle, nodules of the same character are sometimes found in the cord, and they may soften down into chronic abscesses.

Symptoms and Diagnosis.—Acute inflammation of the cord causes a rapid, painful, and very tender swelling of the part, and, when abscess forms, the skin over it becomes cedematous and reddened, and fluctuation is detected. Tubercular disease of the cord usually causes a uniform enlargement of the vas deferens to the size of a quill or so, but it may lead to nodular swelling of the part, at first rounded and hard, and then softening down into a fluctuating swelling, which bursts and discharges thin, flaky, curdy pus. The diagnosis will be at once made by noticing tubercular disease of the testicle, and perhaps of other organs also.

TUMOURS.—The commonest of the solid tumours is lipoma; these growths spring from the scattered nodules of fat normally found in the cord, and which are continuous above with the subperitoneal fat. Myxoma and a mixture of mucous and fatty tissue—myxo-lipoma—also occur, especially late in life. Sarcomata may grow from the cellular tissue of the cord. Colloid and encephaloid cancer have been found springing from the vas deferens, and possibly also from the remains of the funicular process of peritoneum. These various forms of tumour have their usual pathological characters: the lipomata are often pedunculated; the sarcomata and carcinomata infect the lymphatic glands in the iliac fossa and other internal organs, and they and the myxomata may recur after removal.

Fatty tumours grow slowly, and, after attaining a certain size, may remain sta-

tionary for years. They are painless, smooth, soft, often lobulated in outline, and generally very movable. In some cases, when the patient stands up, a little swelling falls down through the external ring, and then, on the patient's lying down, it slips up again within the inguinal canal; this apparent reducibility of the tumour is unattended with gurgle, and, by careful manipulation, it is generally possible still to feel the tumour over the internal abdominal ring, especially if the finger be passed up into the inguinal canal. Where the tumour lies partly within the inguinal canal, it has a thrusting—not an expansile—impulse imparted to it by a cough. When the testicle is pulled down so as to put the cord upon the stretch, the mobility of the tumour is greatly lessened. From the position and apparent reducibility of these tumours they may be mistaken for hernia. From an enterocele they are to be distinguished by their greater mobility, dulness on percussion, constancy of size, absence of pain, absence of gurgle on reduction, and of expansile impulse on coughing; and by the fact that traction on the cord fixes the tumour and prevents its reduction. To epiplocele the resemblance is much closer, as both alike consist of masses of fat, and, like the tumour, the hernia may be irreducible. Lipoma is, however, free from pain or any sense of dragging, such as is met with in epiplocele; it is also more movable, often slipping about freely on its narrow pedicle; while its position, mobility, and apparent reducibility are affected by traction on the cord to a much greater extent than is an epiplocele. An epiplocele can always be traced quite up to the internal abdominal ring; many lipomata spring from the cord lower down, and when this can be distinctly demonstrated there can be no difficulty in the diagnosis.

Myxo-lipoma can only be distinguished from simple lipoma by careful microscopical examination, and by its tendency to recur after removal. Myxoma of the cord grows more rapidly and continuously than lipoma, is very soft, rounded in outline, and does not infect the iliac glands; the tumour may attain a considerable size. No differential diagnosis can be made between sarcoma and carcinoma of the cord: both alike are rare as primary affections. The tumours are firm, more fixed than lipoma, grow steadily, and generally rapidly, infect the iliac and lumbar glands, and become adherent to and fungate through the skin over them if left alone; in their later stages, the tumours

become uneven in outline and unequal in consistence.

Malignant disease of the testicle often spreads up the cord to the groin, and may form considerable masses in it, and after castration the disease may recur in the stump of the cord. Nothing is known of the causes of the primary solid tumours of the cord.

Treatment.—An acute inflammatory swelling of the cord is to be treated by rest and cold, or, if that fail to relieve quickly, by hot belladonna fomentations. Should an abscess form, an early incision is to be made into it; if considerable induration of the cord be left behind, it may be removed by a succession of small blisters. Tubercular disease of the cord requires the same treatment as the similar affection of the testicle. See TESTIS, Diseases of the. If a lipoma of the cord do not cause any trouble or inconvenience, and have ceased to grow, no treatment is required. Where, on the other hand, the tumour is still increasing in size, or from its size or position is a source of annoyance to the patient, it should be removed through a simple incision down to it, care being taken to enucleate the entire growth, but without inflicting injury upon the vessels or duct of the cord. To wear a truss for a small lipoma in the inguinal canal simulating a hernia is neither beneficial nor injurious. When, in operating for a hernia, one of these growths is detected, it should be removed. If, in a patient believed to have a lipoma of the cord, symptoms of intestinal strangulation come on, the surgeon should cut down upon the tumour and explore the part, as a small hernia might be concealed beneath it. A myxomatous tumour should be removed as early as possible, care being taken to keep outside the delicate capsule surrounding the growth. Malignant tumours of the cord should be excised if the iliac glands are not evidently infected, and as these growths infiltrate the cord and have a great tendency to recur, the entire cord, and the testicle, should be removed with the tumour. In the removal of benign tumours of the cord, castration is never justifiable.

A. PEARCE GOULD.

SPERMATORRHOEA.—The term spermatorrhœa is in every respect a bad one, and has been much abused. In its true etymological sense it means the discharge of the spermatic fluid or semen, without sexual desire or sexual excitement; and the malady from which the patient suffers has come to be regarded as the direct outcome of the loss of the seminal

secretion, when it is really due to the condition of the patient's mind, which, as Sir James Paget says, 'in reference to his sexual organs, is unsound.' The term has also been much abused, and often loosely applied by patients to the discharge of mucus, either prostatic, urethral, or vesical; to the gleet discharge due to a stricture or inflamed patch on the mucous membrane of the urethra, and even to the flocculent cloud of mucus which occurs in healthy urine, or the white deposit of phosphates when the urine is alkaline in some forms of dyspepsia.

Furthermore, the term has been applied to a frequent or even an occasional involuntary emission occurring during sleep, attended by erection and under the influence of lascivious dreams. These frequently occur, especially in early manhood, and often denote an excess of health and strength, and are simply the result of a hyper-secretion of the testes, occurring most frequently in young men of an excitable temperament.

By the term spermatorrhœa is meant a peculiar condition of hypochondriasis, engendered and maintained by an irritable condition of the sexual organs, which causes the frequent escape of seminal fluid, with or without the patient being aware of it. It is extremely doubtful, however, whether this latter condition, when the semen is passed without the knowledge of the patient, ever occurs; and such conditions as those spoken of by Lallemand, where seminal emissions occurred during micturition, and where there was a constant loss of semen with the urine, must be received with a considerable amount of doubt.

Such a condition as that described above, though happily a rare affection, undoubtedly does exist, and requires most careful consideration on the part of the surgeon, since it entails the greatest suffering, not only on the patient himself, but also often on those with whom he is associated by the closest ties.

Causes.—There can be no doubt that the most potent cause of spermatorrhœa is to be found in the habit of self-abuse, or in repeated venereal excitement in sexual intercourse. But other forms of local irritation, such as balanitis, phimosis, varicocele, rectal irritation from hæmorrhoids or fissure, intestinal irritation from the presence of worms, constipation or some derangement of the digestive organs, have all been accredited with causing this disease. Dicenta states that, in 500 cases of spermatorrhœa, he met with about 100

cases of some derangement of the digestive organs, generally constipation or dyspepsia, and about 50 of hæmorrhoids. Any of these conditions may excite the habit of masturbation, or, on the other hand, masturbation may cause most of them.

The exact manner in which the irritability of the sexual organs is induced, and what connection it has with the habit of self-abuse, is still the subject of considerable doubt. Trousseau believes that spermatorrhœa is due to some imperfection in the nervous system of organic life, since it is so commonly found in men who have suffered from incontinence of urine in early years; and regards masturbation as an indirect proof of a vitiated condition of the nervous system.

Dr. T. Clemens believes that hyperæsthesia of the urethral mucous membrane is a frequent cause of spermatorrhœa, and that the hyperæsthesia is due to some affection of the spinal cord, which has become 'exhausted' from misuse and excessive irritation of the genitals.

Lallemand, on the other hand, takes a very different view of the cause of spermatorrhœa, and believes that the disease is almost exclusively the result of irritation of the spermatic ducts arising from chronic inflammation, and that an old attack of urethritis is the most frequent cause of the seminal emissions.

Symptoms.—Almost always, if not always, spermatorrhœa begins with frequent nocturnal emissions, at first with, and afterwards without, erotic sensations. As the disease advances, these emissions become more frequent, occurring twice or thrice or even oftener in the same night, and unaccompanied by erection and even without any sensation being experienced by the patient. In consequence of this, partly as a result of the discharge, but also to a far greater extent from the mental disquietude which is produced, the patient becomes weak and irritable; he complains of heaviness and languor, disinclination to go about his ordinary occupations, and inability to fix his attention on any kind of work. As the malady progresses, emissions take place during the day, as well as at night, and from any slight cause, such as friction of the clothes in walking or riding; or, a mere reference to sexual matters or licentious talk may occasion an emission, without the usual amount of erection or sensation. If sexual intercourse is attempted, ejaculation takes place almost immediately, even before the introduction of the organ, and the act is therefore not

properly accomplished. This adds to the mental disquietude of the patient, who imagines that he has become impotent, and constantly broods over the subject, thus increasing his mental distress.

As a result of this uneasiness his digestion becomes impaired; he suffers from flatulency, heartburn, oppression in his breathing, and shortness of breath and constipation. He complains of aching pains, especially in the loins, and at last sinks into a condition of hypochondriasis, devoting the whole of his thoughts to his own unhappy condition, and taking no interest in the ordinary affairs of life. He is languid and depressed in manner and devoid of all energy. His eye is dull, his countenance pale and anxious, his expression listless. There is often impairment of vision, accompanied by extreme sensibility to light, and buzzing or singing noises in the ears. He may thus gradually drift into a condition of melancholia, and entertain the firm conviction that he is incurable and is fast sinking into an early grave; or he may even sometimes develop suicidal tendencies. The late Mr. Gascoyen has well summed up the symptoms of spermatorrhœa, when he says that they are a mixture of 'sexual irritability, mental uneasiness, dyspepsia, and hypochondriasis.' This exactly expresses the whole state of the case. As a result of sexual excesses or self-abuse, or it may be from some of the other causes enumerated above, an irritability of the sexual organs is set up, which induces emissions without adequate cause. Conscious of his immoral habits, the patient regards this condition as of serious import, and hence falls into a state of mental uneasiness, which speedily produces derangement of the digestive organs, and, as a natural sequence, all the horrors of an advanced hypochondriacal state. The symptoms, therefore, can scarcely be said to be due to the emissions, though in the first instance induced by them, but rather to some over-sensitive condition of the nervous system. It is not a disease of the sexual organs, but a disorder of the nervous centres. *See HYPOCHONDRIASIS.*

Diagnosis.—In the investigation of a case of spermatorrhœa, the first thing to do is to ascertain that the discharge is undoubtedly semen, and not the glairy fluid which sometimes exudes from the urethra, and which is either the natural secretion of its mucous membrane increased in quantity, or is derived from the prostate in cases of prostaticorrhœa; and that it is not the discharge from a stricture or the remains of

an old-standing gleet. This point must be cleared up by the microscopical examination of the fluid, and the existence of true spermatorrhœa established by the presence of spermatozoa in it. Some care requires to be exercised in this, and it is well to examine the discharge on two or three occasions before coming to a definite opinion. The patient may recently have been attempting sexual intercourse or have been guilty of self-abuse, when spermatozoa would probably be found in the discharge, and this might lead to error. When the presence of spermatozoa has been definitely settled, the cause of the spermatorrhœa must be sought for. The condition of the external genitals must be examined; the presence or absence of balanitis, phimosis, or varicocele must be determined; the condition of the urethra must be investigated, and the existence of a stricture or tender spot on the mucous membrane ascertained, if it exists, by the passage of a bougie, of which the acorn-pointed one is the best suited for this exploration. The presence or absence of any rectal or intestinal irritation must be ascertained, and the general health of the patient, especially in regard to dyspepsia and constipation, inquired into. Finally, strict inquiries must be made as to the habits of the patient, whether he is still addicted to self-abuse, as unhappily is too often the case in the confirmed examples of spermatorrhœa.

Prognosis.—The issue of a case of spermatorrhœa depends, to a very great extent, upon whether the patient has entirely relinquished his evil habits or not. In many of these cases no persuasion, no fear, no threat will induce the patient to relinquish them. He appears to have entirely lost all power of self-control, and though he may promise and faithfully intend to keep his promise, he will relapse again and again. The outlook in such a case is gloomy. In some instances dementia is induced, in others active disease is set up as the result of the debilitated condition into which the patient has been reduced, and he falls a victim to his own folly. When, however, the evil habits are relinquished, the prognosis is hopeful, and the patient generally gets well under the influence of medical treatment and advice, and may be restored to perfect health and full vigour of mind and body, and become a useful member of society and a happy man.

Treatment.—The first point in conducting the treatment of a case of spermatorrhœa is to induce the patient to abstain,

at once and for ever, from his habits of masturbation, if he be still addicted to them. Without this, no other treatment can be of any avail. Every effort should therefore be made by the surgeon to induce him to relinquish them, by laying before him the consequences of his folly, if he persists in it, and assuring him, on the other hand, that if they be given up a perfect recovery may be confidently anticipated. In order to carry this out with greater effect, the surgeon should strive by every means in his power to obtain the confidence of his patient. In many cases, the sensible man will believe what he is told and will abstain from all further vicious habits, and his cure will already be half-effected. Others, on the other hand, do not appear to possess sufficient moral self-control to abstain, and, in such cases, it is advisable to keep the penis constantly sore with some blistering fluid. A ring of blistering fluid is to be painted round the penis, and as soon as this is healed or nearly healed, a second ring is painted on some other part. This is generally effectual in breaking the habit, at all events for a time, and patients will sometimes ask that it may be done, of their own accord, since they have not confidence in their own power of self-control. See MASTURBATION.

After this, the main treatment must be directed to the patient's general condition, to improving his health and keeping the mind and body engaged. This will have a far more beneficial effect than any medicine. All sedentary habits, with mental overstrain and excessive reading, must be abandoned, and the patient actively engaged in some outdoor occupation or pursuit. Something congenial to the patient's tastes should be found, so that, while his body is actively engaged, his mind may become engrossed in the pursuit in which he is engaged, instead of brooding over his troubles. A change of air, especially to some bracing seaside place, is desirable, where he may engage in fishing, rowing, boating, or athletics of some kind, so that each night may find him healthily tired. He should rise early, as soon as he wakes, and take a cold or tepid bath, or, what is better, a plunge in the sea. His companions should be cheerful and amusing, and it should be their endeavour to keep his mind occupied with their various pursuits and pleasures. His diet should be nourishing and unstimulating, and all highly seasoned meats and condiments should be avoided, and he should

eat no supper or heavy meal before retiring to rest. He should sleep on a hard, horsehair mattress, without too much clothing, and it is a good plan to advise his getting into the habit of causing his bowels to act the last thing before he goes to bed, so that a loaded rectum may not press upon his vesiculæ seminales. He should also be cautioned against sleeping on his back, and may be prevented from doing so by having some hard body, as a cork, strapped over the sacrum when he retires to bed.

Dyspeptic symptoms must be corrected by appropriate medicinal treatment, and the state of the bowels carefully attended to. If sleeplessness exist, it must be combated by the bromides of potassium or ammonium; but it is better to avoid the exhibition of these remedies, if it can be done, and to trust to active outdoor exercise inducing the weariness which will produce natural sleep. These measures, if steadily persevered in, will be found more efficacious than any special medicines, though these have been recommended by some. Trousseau strongly advocates the use of belladonna, and states that its utility depends upon its undoubted influence upon the entire nervous system, particularly on the encephalon and spinal marrow. Digitalis and aconite have been given with the same view, and to nitrate of silver, used internally, favourable results have been attributed.

Any special cause which can be discovered for the disease must, of course, be at once removed; such as an elongated prepuce, a phimosis, a varicocele, or hæmorrhoids or a fissure of the anus, and thus all source of irritation be got rid of.

Of local remedies, the one most extolled is the application of nitrate of silver to the prostatic portion of the urethra, either in the form of solid caustic, as recommended by Lallemand, or in solution, by means of the syringe catheter. The utility of this treatment has been a good deal disputed, and though there can be no doubt of the advantages derived from its use in cases of simple prostatorrhœa, the evidence in favour of its employment in spermatorrhœa is by no means conclusive.

T. PICKERING PICK.

SPHACELUS. See GANGRENE.

SPHINCTER ANI, Spasm of. See FISSURE OF THE ANUS.

SPICA BANDAGE. See BANDAGES.

SPINA BIFIDA.—*Definition.*—The term, first applied by Tulpius at the commencement of the seventeenth century, is used to define certain congenital malformations of the spinal canal, with prolapse of some of its contents, in the form of a fluid tumour.

Pathological Anatomy.—Most commonly this malformation affects the posterior segments of the vertebræ, and the tumour appears on some part of the back; but in a few cases the bodies of the vertebræ are found cleft, and the tumour then projects into the thorax, abdomen, or pelvis, between the lateral halves of the bodies affected. The tumour, at birth, varies very much in size—from that of a hazel-nut to that of a fist, and it may become very much larger. In form it is more or less hemispherical, its exact shape being largely determined by the size of the spinal fissure through which it issues; sometimes, the tumour is distinctly bi-lobed in its vertical axis; it may have a broad base, or be attached by a narrow pedicle, which may be either long or short. The tumour is usually situated in the median line, sometimes, however, with a little inclination either to the right or the left side; it usually occurs as a single tumour, but cases are on record where more than one tumour has been present. In St. George's Hospital Museum there is a specimen which, on the surface, appears to be constricted about its middle, and this constriction corresponds with a horizontal septum within, which separates two independent cysts. The sac is not infrequently multilocular, and in University College Museum there is a remarkable specimen of such a cyst; but there are no instances of two distinct tumours in any of the London museums. An occasional combination of spina bifida with congenital sacral tumour has been recorded.

The spine may be affected in any one of its regions. Demme records 57 personal cases, divided as follows:—5 cervical, 2 cervico-dorsal, 15 dorsal (two of which were instances of double tumours) 17 lumbar, 11 lumbo-sacral, 7 sacral. The writer's own cases, 19 in number, have all been lumbar or lumbo-sacral, with one exception, and this was at the sacro-coccygeal junction. Wernitz gives 210 collected cases (the above not included), with the following analysis:—Cervical 12, cervico-dorsal 3, dorsal 6, dorso-lumbar 9, lumbo-sacral 127, sacral 53. An examination of 125 specimens in various pathological museums gave the following results:—1 affecting the whole column, 9 dorsal, 9 lumbar, 68 lumbo-sacral, 21 sacral,

1 sacro-coccygeal, 3 dorsi-lumbar, 7 dorsi-lumbo-sacral, and 6 which could not be defined. It will thus be evident how largely the malformation affects the lower part of the spine—a significant fact when taken in conjunction with the relatively late period at which its development is completed. The anatomy varies considerably; the tumour may be a simple dilatation and protrusion of the spinal meninges (meningocele), or it may contain more or less of the cord and its nerves (meningo-myelocele), or it may be a dilatation of the central canal of the cord with prolapse of its membranes (syringo-myelocele). An analysis of the 125 specimens just alluded to showed that 10 were meningoceles, 79 meningo-myeloceles, 2 syringo-myeloceles; 19 were macerated specimens, and 15 were undeterminable or not dissected.

All these points are of importance, chiefly in prognosis, and as affecting the probable results of treatment. The cleft in the spine may involve all the vertebrae, or may affect but a single bone; more commonly three or four vertebrae are at fault. On examination, the spinous processes are absent, and the laminae, more or less ill-developed, are found separated by the protruding sac. The sac may, or may not, be covered with normal skin; in the majority of the recorded cases of pure meningocele the skin is normal; it may also be normal in cases where the cord is intimately involved in the deformity. In the latter cases, however, more usually the skin surrounds the base of the tumour, and extends on to its surface for about half to three-quarters of an inch, and then becomes lost in the membrane which completes the sac. In a few cases, the membranous part of the sac corresponds with the extent to which the altered cord is adherent to the sac-wall. In others no such limitation exists. There is strong presumptive evidence, however, that this membranous area represents the attenuated neural tissue of the spinal cord from which the nerves within the sac really take origin. In St. Thomas's Hospital Museum there is a specimen of spina bifida in the dorsal region, in which the spinal cord, after blending with the sac-wall, may be found normally constituted in the lowest part of the sac, and in the entire part of the vertebral canal below the sac. This membrane is often white and glistening, like distended dura mater; sometimes it is red and inflamed; it may be so thin as to burst shortly after the child's birth, or strong enough to withstand considerable ill-usage.

Inside the sac there is a closely-fitting lining of arachnoid, so that the cavity of the majority of these tumours corresponds to the subarachnoid space. The pure meningoceles are more usually dilatations of the arachnoid cavity. The extent to which the cord enters the sac varies within considerable limits. If the deformity affects the lowest part of the spinal column, the cord will be less manifest, because here, at all ages, it is smaller in size than in other regions; when the cleft occurs in the lumbar region, then the cord, being larger, is more obvious. It will be remembered that the cord extends through the whole length of the spinal canal at the early period when spina bifida commences, so that there is nothing extraordinary in finding the cord even in a sacral spina bifida; and, in a very large proportion of the specimens preserved in the London museums, the cord, to a greater or less extent, is adherent to the posterior wall of the sac. In many cases a longitudinal furrow can be seen, giving the tumour a bi-lobed appearance in its vertical axis; in a few cases, as first pointed out by Virchow, and figured by him, there is a distinct depression or umbilicus corresponding to the insertion of the tip of the cord. In the former class, the cord passes out of the vertebral canal, and follows the curve of the tumour. In the latter, it passes more or less through the centre of the tumour to reach its posterior surface. Thus, the longitudinal furrow or the central umbilicus is, in some measure, evidence of the extent to which the cord is adherent; and whenever treatment is contemplated, it suggests that this median vertical portion of the sac, at any rate, must not be interfered with.

The spinal nerves belonging to the prolapsed cord arise within the sac, and pass forwards to their respective foramina; their anterior and posterior roots can usually be distinctly traced. They are sometimes found separated by a structure continuous with the ligamentum denticulatum, but far exceeding its normal proportion, which then forms a prominent falciform fold on each side of the middle line, corresponding to the interval between the anterior and posterior nerve-roots of either side. In some cases of sacral spina bifida, the spinal nerves arising from the cord within the sac, and even those arising from it above its entrance into the sac, take an upward course in order to reach their proper intervertebral foramina; this upward direction of the nerves is most common for the lumbar nerves. In the cases where the distended

central canal of the cord forms the interior of the sac, the nerve-arrangement varies a little; the sac, of course, does not contain any nerves, and it might hence be concluded that the case was one of simple meningocele. Dissection, however, shows the nerve-roots lying in the loose subarachnoid tissue between the innermost membrane and the other component layers of the sac-wall; they pass thence round the sac-wall towards their respective foramina of exit. The central canal, however, is sometimes larger than normal throughout the cord above the sac, in cases of spina bifida, without appearing to be involved in, or essentially connected with, the deformity.

Causes.—Early classical authorities are about equally divided in opinion between a primary dropsy of the central nervous system, interfering with the normal development of the spinal canal, and a primary arrest of development in the laminae of the vertebrae, allowing of prolapse of the nerve-centres and their membranes. There is little beyond conjecture in favour of the former hypothesis; and while it must be admitted that some arrest of development is found in most cases, there is at least one case in the College of Surgeons where no such arrest occurred. The association of other malformations—harelip, ectopia vesicae, anencephalus, sacral tumour—doubtless speaks in favour of some congenital error in development as the most frequent cause, without, however, very clearly indicating in what the first step really consists. With regard to cases of pure meningocele, it seems not improbable that, owing to deficient development in the vertebral arches, and consequent lack of support, the spinal membranes prolapse in response to the increasing pressure of the cerebro-spinal fluid, or to its accumulation at the point of least resistance.

For the forms of spina bifida in which the cord and its nerves are attached to the sac, Cruveilhier advanced the opinion, previously foreshadowed by Morgagni, that the essential lesion is adhesion between the cord elements and the external skin. This opinion has since been independently put forward with much force by Ranke. Such an adhesion of the spinal cord with the skin cannot take place when the neural arches are once closed. The deformity, therefore, if this view be correct, must begin in the earliest period of foetal development—at a time, indeed, when the arches are still wholly undeveloped; that is to say, before the spinal membranes, the intervening structures, and the skin have been differ-

entiated. Hence, the error of development consists in the persistence of a foetal condition—a non-differentiation of blastoderm—rather than an adhesion in the more usual acceptation of the term. The formation of the sac (which is not an essential part of the deformity) proceeds automatically from the pressure of the cerebro-spinal fluid and the absence of adequate resistance. The cord, which is adherent to its membranes, together with the nerves arising from it, is displaced from the canal by the enlarging sac; they thus effectually prevent union of the vertebral laminae. The spinal nerves are necessarily elongated, and it is, perhaps, this condition which partly accounts for the varying degrees with which their functions are implicated.

Translucency of the sac is sometimes regarded as evidence of its purely fluid contents; but this is a very delusive diagnostic guide. In a case recently under the writer's care, the sac appeared quite translucent; but, after death, the cord was found within and adherent to the sac, and large nerves traversed it on their way towards their intervertebral foramina. Dr. Halliburton has favoured the writer with the following analysis of fluid taken from a recently treated case: Water, 989·75; solid matters, 10·25. These latter consisted of—extractives and soluble salts, 9·406; insoluble salts, ·218; proteids (almost exclusively *globulin*), ·842; sugar, ·002. The composition of the fluid, according to Ranke, is:—·061 per cent. albumen out of a total of 1·06 per cent. solids; these yield 82·17 per cent. of their bulk, ash. This ash contains six-and-a-half times more soda than potash.

Diagnosis and Symptoms.—The diagnosis of spina bifida is not difficult. Given a congenital cystic tumour on some part of the vertebral column, and situated in the median line, the probability is very great that we have to deal with a spina bifida. Other cystic tumours may, undoubtedly, occur near the spine; thus, situated deeply, broad-based collections of fluid are sometimes met with, which Virchow and other authorities regard as sacs which have been gradually shut off from the spinal canal. Especially frequent in the sacral region, and extending towards the perineum, large pendulous sacs ('false spina bifida'), which have no connection with the spinal canal, are sometimes found. In many cases of spina bifida, a communication between the sac and the brain can be appreciated by alternately compressing the one and the other, the proceeding not infrequently

giving rise to spasm of the limbs, or to other signs of nerve-irritation. The sac varies in its tension; in a few cases it can be emptied. When the child's head is placed low, the sac relaxes; when the head is raised, it becomes more distended: the distension is influenced also by respiration, and by crying or other effort. In a few cases there is a distinct respiratory rhythm, synchronous with the pulsation at the anterior fontanelle. A young woman, with a very large tumour, recently seen by the writer, distinctly felt the wave of fluid between her spina bifida and the head. Many children with this deformity are born marasmic, with the lower extremities cold and atrophic, and sometimes quite paralysed. The sphincters of the bladder and rectum are also affected in many cases. This is presumptive evidence that the cord is involved. A post-anal dimple is often found associated with this deformity. When the sac is not very tense, the commencement of the cleft in the vertebral arches can often be felt, and is then an important factor in diagnosis. The writer knows of no symptoms by which the three varieties of spina bifida can be differentiated *with certainty* during life. A tumour situated high up on the spine, with a covering of normal skin, translucent, and having a narrow pedicle, will in all probability prove to be a meningocele; while a tumour on the lower parts of the spine, with a broad base and a membranous ulcerated sac-wall, accompanied by paralysis of the sphincters or lower limbs, will almost as certainly prove to be a meningo-myelocele.

Treatment.—A cure has not infrequently followed on spontaneous rupture of the sac, but death more often takes place. This is due to draining away of the cerebro-spinal fluid and to meningitis of a septic character, which gradually extends to the brain. The same occurs, too, after puncture in many cases. In all cases alike, then, in attempting treatment, the greatest attention must be paid to cleanliness and to prevent draining of the fluid. If the surface of the sac is ulcerated, still more when it is semi-gangrenous, a dry, absorbent, antiseptic dressing should be applied; and over this a moulded gutta-percha covering which, while it holds the dressing in place, will protect the tumour from injury. One of the most appropriate dressings is iodoform or salicylic wool; or, the tumour being well sprinkled over with iodoform, a plain wool dressing may be laid on. If the wall of the sac is very thin, but not actually ruptured, it is well to paint it

freely with collodion, in which a little iodoform has been dissolved; a thin layer of absorbent wool first laid on, and impregnated with the collodion, gives solidity and firmness to the sac-wall, and sometimes even suffices to cause the sac to shrivel up. This application should extend for some distance round the base of the sac. Such a protection frequently suffices to arrest the growth of the sac, if it does nothing else. Meanwhile, time is gained for the general health to improve, if it will. The frequency with which the spinal cord terminates in some part of the wall of the sac, and with which the spinal nerves pass through the sac, contra-indicates such methods of treatment as removal of the sac either with the knife or by means of a ligature around its base. Notwithstanding the fact that some cases treated successfully by these methods have been published, the remark holds good because of the impossibility of diagnosing cases in which the nerve-centres are not involved.

By far the most successful treatment is that proposed by Dr. Morton of Glasgow. He withdraws a portion of the fluid—'not more than half of the fluid contents'—and then injects a solution of iodine in glycerine (℞ Iodi gr. x., Potassii iodidi gr. xxx., Glycerini f3j.). Of this 'from half a drachm to two drachms are injected, according to the size of the protrusion.' In the management of a case of spina bifida, among other points of importance Morton gives the following:—'The child should be in a thriving condition; the puncture should be carefully closed by collodion or otherwise, so as to prevent further escape of fluid; the parts must be gently handled and protected by the nurse; the injection is to be repeated if required.' Velpeau was the first to use iodine injections. He emptied the sac, and then injected some iodine solution, which was allowed to escape again after a short interval. A few successful cases, treated by other methods, may be found scattered through medical literature; but Morton's method is at present the most successful of any in vogue. In puncturing a spina bifida, always avoid the apex or membranous portion of the sac; puncture near the base, and select a spot where the skin is normal. The utmost that can be expected from treatment of such a serious malformation is a cure of the spinal protrusion. If paralysis exists, it will not be benefited by treatment; in a few cases, paralysis has come on subsequently; while very occasionally sudden death has followed interference. Hydrocephalus may

complicate the spina bifida, or appear as the cure of the spina bifida proceeds. Treatment should always be delayed for a few weeks—that is to say, until the infant's general health has had time to establish itself; palliative measures, such as the application of collodion, being meanwhile adopted to prevent the increase of the tumour. ROBERT WILLIAM PARKER.

SPINAL CORD. *See* BACK AND SPINE, Injuries of the.

SPINE, Diseases of the. *See* CARIES OF THE SPINE; LATERAL SPINAL CURVATURE; ANTERO-POSTERIOR SPINAL CURVATURE.

SPINE, Injuries of the. *See* BACK AND SPINE, Injuries of the.

SPIRILLUM.—A spiral thread-like organism, one of the SCHIZOMYCETES, the turns of which are arranged around a longitudinal axis. When the organism grows to a considerable extent, and secondary flexures are produced in its course, it has been termed *Spirochæte*. This form of spiral organism has received the specific name 'denticola,' and is found in the mouth and nose and in dental abscesses. The most important spirillum is the *S. Obermeieri*, which is found in the blood of patients suffering from relapsing fever. It appears in the blood in greater quantity when the attacks of fever recur, and disappears when they vanish. The symptoms of relapsing fever have been communicated, from man to the monkey, by inoculating the latter animal with human blood containing the organisms (Carter).

Other spirilla found in stagnant water are *S. undulum* and *S. volutans*, the latter being a very large organism and provided with a flagellum on each end.

VICTOR HORSLEY.

SPLEEN, Diseases of the.—Certain of the diseases to which the spleen is liable are of interest to the surgeon, because it is now a well-established fact that the whole organ may be removed from the human subject in suitable cases, not only with safety to life, but with actual improvement to health.

The spleen may be dislocated, and pain may be produced by the resulting drag upon its vessels and nerves; it has even been found in the pelvis. It may be malformed, simply fissured or lobulated, or multiple. In the latter case, a number of little spleens may be found, merely attached to one another by their nerves and blood-vessels.

Dislocation, if accompanied by severe pain, may give rise to the question of oper-

ative interference, and possible malformation must be borne in mind in cases of doubtful abdominal tumour occupying the region of the spleen. Dislocated or wandering spleens have been twice successfully removed—once by Péan and once by Martin. Injury, simple hypertrophy, leukæmic hypertrophy, malignant hypertrophy (sarcoma or carcinoma), abscess, hydatids, and cysts, are the conditions which may raise the question of possible cure by operation.

INJURIES.—These may arise from incised wound, gun-shot wound, or rupture from direct or indirect violence, and there can be no doubt that in any case in which a clear diagnosis of either of these conditions can be made, and in which the symptoms indicate danger to life, the surgeon is not only justified, but bound to open the abdomen, and either to deal with the injury on general surgical principles or, if this be impossible, to remove the organ.

SIMPLE HYPERTROPHY.—This condition may be accompanied by softening or hardening of the organ, or it may retain its normal consistence. Endocarditis, syphilis, long exposure to malarial influences, intermittent fever, and ague are the common causes; but the spleen may be found enormously hypertrophied without any obtainable history of previous illness.

In this, as in other enlargements, it may form a tumour almost filling the abdomen and extending into the pelvis, so as to be mistaken for an ovarian or uterine tumour. Its upper part will, however, be found in its proper situation, and this, together with the notch, which can usually be distinguished, should prevent a mistake in diagnosis. The fact that the intestines do not lie in front of it, may help to distinguish an enlarged spleen from a renal tumour.

Zaccarelli of Naples is credited with the successful removal of an hypertrophied spleen, so far back as 1549; and in more recent times Péan, Volney d'Orsay, and Franjolini have each added a successful case to the records of this procedure. But against these at least an equal number of fatal cases must be recorded, and it remains an open question whether the deliberate removal of a spleen, simply because it is greatly hypertrophied, is a justifiable operation, unless it can be clearly shown that the condition is causing immediate danger to the life of the patient.

LEUKÆMIC HYPERTROPHY.—The enlargement in this case is so clearly only a part of a general blood-disease, which also affects other vital organs, that operative interference would be contraindicated, even with-

out the terrible list of failures which the records of splenectomy furnish. The leukaemic spleen has been excised in sixteen cases, and all the patients have died.

MALIGNANT HYPERTROPHY (Sarcoma or Carcinoma).—This is extremely rare as a primary disease, and is only of interest to the surgeon in so far as it is necessary to diagnose between the various forms of hypertrophy. The most ardent advocate for the operative treatment of cancer, would hardly include the spleen among the organs which it is advisable to extirpate for this disease.

ABSCESS.—This should be treated by incision and drainage, and in the event of the antecedent inflammation not having caused adhesion between the spleen and the parietal peritoneum, great care should be taken to avoid any fouling of the peritoneal surfaces with the pus. The edges of the opening in the spleen should be accurately and closely sutured to those of the opening in the abdominal parietes, and the cavity drained and, if necessary, washed out from time to time with antiseptic solutions.

HYDATIDS should be treated in exactly the same way as abscess; suture, drainage and washing-out being employed, after the thorough evacuation of the small cysts and loose membranes.

CYSTS.—Cystic disease of the spleen, other than that arising from the presence of hydatids, is very rare; but both single and multilocular cysts have been met with, and the spleen has been successfully extirpated for cystic disease by Péan, Credé, and the writer.

SPLENECTOMY.—If complete extirpation be decided upon, the incision outside the rectus, recommended by Langenbuch for extirpation of the kidney, should be employed. The preparation of the patient and general procedure should correspond with that described in detail for OVARIOTOMY. The pedicle should be transfixed and ligatured in two or more portions, great care being necessary to avoid including a portion of the pancreas in the ligatures, and also to avoid the slipping back of any small vessel between the layers of the omentum, an accident which happened to the writer when removing an hypertrophied spleen, and which led to the death of the patient. If the ligatures can be applied before the tumour is turned out of the abdominal cavity, and therefore before the pedicle is put upon the stretch, it will be much easier to tie the ligatures securely and avoid the above-named accident; but with very large tumours this may be impossible.

Increase in the number of white cells in the blood, enlargement of lymphatic glands, enlargement of the thyroid, and anaemia have been said to follow the successful extirpation of the spleen, but were not observed by the writer in his case of successful extirpation for cystic disease; the patient recovering more slowly than after ovariectomy, and with more symptoms of disturbance about the pedicle than are common after the latter operation, but now enjoying the most perfect health.

J. KNOWSLEY THORNTON.

SPLEEN, Rupture of the.—A less common injury than rupture of the liver, it is generally complicated with other injuries of the abdomen and chest. The degree of rupture varies.

Causes.—Blows, kicks, falls, wheels of vehicles passing over the organ; penetration by fractured ribs; gunshot injuries.

Symptoms.—The nature and position of the injury received must be borne in mind, as there are no distinctive symptoms. There will be marked general shock, anxious countenance, coldness of the trunk and extremities, feeble pulse, sighing respiration; abdominal pain, especially over the seat of injury, dulness on percussion over the splenic area due to extravasated blood.

Prognosis unfavourable, as, owing to the vascularity of the organ, the hæmorrhage is generally severe; more so than when the liver is similarly injured. If the parenchymatous tissue be not very extensively torn, recovery may take place. In the surgical history of the American war three cases of recovery are recorded, two being the result of gunshot injuries and the third a bayonet wound. If the shock and hæmorrhage do not lead to an immediately fatal result, peritonitis and abscess are the complications to be feared. See GUNSHOT WOUNDS.

Treatment.—Rest in the horizontal position; warmth to the general surface of the body; ice, or warm fomentations, over the region of the spleen; morphia subcutaneously or by the rectum, to relieve pain. Brandy or egg-flip in teaspoonful doses at frequent intervals.

Should symptoms of internal hæmorrhage continue, no external wound existing, abdominal section at the edge of the left rectus muscle is to be recommended. If laparotomy shows that the hæmorrhage will not cease by exposure or the application of the thermo-cautery, the splenic artery may be ligatured or the spleen itself removed, either directly or by means of a ligature. This last procedure has been successfully

accomplished. All blood must be cleared from the peritoneum, and the abdominal cavity be thoroughly washed out with warm antiseptic lotion, carefully sponged dry, and closed after the introduction of a glass drainage-tube.

THOMAS F. CHAVASSE.

SPLENECTOMY. *See* SPLEEN, Diseases of the.

SPLINTS are surgical appliances used to maintain injured or diseased limbs at rest in accurate position, and to prevent or correct deformities. The materials used for splints are either rigid, such as wood or metal, or are capable of being moulded to the shape of the limb, such as leather, felt, or gutta-percha. Wooden splints are made of pine or deal boards cut to the required shapes and sizes. A very useful material for wooden splints is that known as Gooch's, or the 'kettle-holder' splint, which consists of strips of wood not quite separated from one another and glued on to oilcloth; it is flexible in one direction and perfectly rigid in the other, so that it is very useful when splints are required to surround a limb, as the thigh in fractures of the femur treated by extension. Metal splints are chiefly used for the lower limb: iron is the metal mainly used, and the splints, such as M'Intyre's and Arnold's, are made according to a fixed pattern and of various sizes, so that it is only necessary to select one of the proper size and pad it. Bars of malleable iron or telegraph wire make useful splints, either alone or in combination with wood or plaster of Paris.

If accurate adjustment to the shape of the limb is required, leather, poroplastic felt, gutta-percha, or house flannel soaked in plaster of Paris, must be used.

LEATHER SPLINTS.—A piece of stout sole-leather, of the required shape and size, should be steeped in a trough of cold water for about forty-eight hours, or until sufficiently softened; the addition of a small quantity of vinegar to the water used will shorten the time required for softening to four or five hours. The limb should be first bandaged with a flannel roller, and the softened leather applied and moulded to the limb and retained in position by a bandage for twenty-four hours, by which time the splint will have 'set' to the required shape; the splint must then be taken off, trimmed, lined, and fitted with eyelet-holes and laces.

POROPLASTIC FELT is made of two kinds—one, Hides', which is perforated with small holes, and the other, Cocking's, which is not. For most purposes the latter is preferable

on account of its greater strength. It consists of felt saturated with resin; it is light and porous; it is easily softened either in boiling water or before the fire, and it rapidly sets on cooling—properties which in the main render it more generally useful for splints than leather. Splints, partially moulded to the leg and other regions, can be obtained from instrument-makers. In these splints the bony prominences are well allowed for, so that it is a very easy matter to finish the moulding to a particular limb. Felt is undoubtedly the best material for spinal supports; it is lighter, more comfortable, easier to remove than plaster of Paris, and is quite strong enough for the purpose.

GUTTA-PERCHA is not porous, and on that account is not so comfortable to wear as leather or felt. It is quite easy to mould, but this requires a little care and experience. The water should not be too hot, or the gutta-percha will rapidly lose its shape, particularly if lifted out of the water by one end; the water used should be about as hot as the hand can momentarily bear. When sufficiently softened, the gutta-percha should be lifted out on a towel and plunged for an instant into quite cold water, which will cool it enough to be bearable by the patient, and will cause it to set enough to be easily manipulated without stretching, though not so much as to interfere with exact moulding. When partially set, the splint may be removed to quite cold water, in which it will rapidly set and harden. When moulding the splint, the bandage which is used to fix it in position should be wet, or it will stick to the softened gutta-percha.

MILLBOARD is not often used as a permanent splint, but, in combination with starched bandages, it is useful. Strips about four or five inches wide should be thoroughly softened in boiling water, steeped in hot starch solution, and then placed lengthwise along the limb outside a flannel or layer of cotton-wool, and fixed in position by a starch bandage. It is well to tear the half-divided strips of millboard, and to rub down the edges so that they may lie more comfortably against the limb.

Starch, plaster of Paris, paraffin, &c., may be employed to form immovable splints. *See* IMMOVABLE BANDAGES.

In the antiseptic treatment of compound fractures and excisions of joints, two methods are possible:—(1) To place the splint outside the dressing, or (2) to place it next to the limb and enclose it within the dressing. In the first method the splint is obliged to be taken off at each dressing—a pro-

ceeding which involves more movement of the fragments and more pain to the patient than is desirable; in the latter method there is the liability that the splint will get soiled with the discharges, which may decompose and lead to the failure of the antiseptics. The good points of each method may be retained, and the bad ones avoided, by the use of interrupted or bracketed splints. These consist of wood or metal splints applied to the limb above and below the wound, and connected by bridges of iron wire, which, while they maintain the rigidity of the apparatus, allow of the efficient antiseptic treatment of the wound being carried out beneath them.

A combination of plaster of Paris and telegraph wire forms a most satisfactory splint for the treatment of compound fractures and excised joints; in the manner about to be described, it has been extensively employed by the writer and found to be extremely efficient. The following description applies to a case of compound fracture of the humerus, in which the wound is about the middle of the outer side of the upper arm. The bone being held in position, and the elbow flexed at a right angle, the wrist and forearm should be bandaged with a flannel roller, and over this two or three layers of plaster of Paris bandage applied; similar bandages should be applied to the arm above the fracture, and be carried well over the shoulder. Pieces of telegraph wire should be cut and bent so as to form three rectangular splints accurately adjusted to the limb—an inner one reaching from the axilla to the wrist, an anterior one reaching from the front of the shoulder to the wrist, and a posterior one passing from the top of the shoulder to the wrist. The fracture being properly reduced, the wire splints should be applied and fixed by a turn of strapping above and below it, and then immovably secured by three more layers of plaster of Paris bandage. The edges of the plaster case, which bound the interruption above and below, should be trimmed. The three wires alone pass over the seat of fracture, and they stand off from the limb sufficiently to allow of the deeper part of the dressing being applied beneath them. But the apparatus, if used as described so far, is liable to the following accidents:—The blood-stained serum, which oozes from the wound, may trickle beneath the plaster of Paris case and decompose there, and the moisture alighting from the carbolic spray may sodden the bandages and weaken the splint. These objections are met by taking some melted beeswax and

paraffin (equal parts), soaking pieces of absorbent cotton-wool in it and carefully packing them between the limb and the borders of the plaster apparatus, and then painting these and the borders of the plaster apparatus—above and below the interruption, over a width of three or four inches—with the melted wax and paraffin mixture. The completed apparatus forms an immovable support, which allows of the strictest antiseptic precautions in the treatment of the wound.

The method described above was suggested by that employed by Mr. Howse in cases of excision of the knee. He employs a mixture of yellow wax and olive oil in such proportions as render the wax just soft enough to be applied cold without cracking; the mixture is warmed and bandages are passed through it, re-rolled, and allowed to cool. The limb is placed on the excision splint, and fixed by the waxed bandages; the intervals between the limb and the splint are next packed with pieces of absorbent wool soaked with the wax, and the whole apparatus is painted over with some of the hot wax mixture, so as to weld the bandages together.

PADS.—Splints should be well padded before they are applied. Pads may be made of tow or cotton-wool, packed together and wrapped up in soft cotton cloth, for which purpose old napkins or sheets serve very well. Cotton-wool alone is objectionable, as it tends to work into uncomfortable lumps, and, if used, it is well to sew through the pad here and there so as to prevent the wool shifting. A piece of tow wrapped up in a thin layer of cotton wool, and the whole covered by some soft cotton cloth, forms a good pad. Pads should be a little broader than the splint, so that the edges of the latter are well covered; and jointed splints should have separate pads for each piece, so that the angle of the splint may be changed without disturbing the pad. The pads should be fixed to the splint by stitches passing from one side of them to the other behind the splint, in the form of a lace-stitch. Sometimes, it is necessary to employ separate pads to relieve prominent points from pressure—e.g., when treating a broken leg on a back splint, a pad should be placed opposite the tendo Achillis, so as to relieve the point of the heel from pressure.

BILTON POLLARD.

SPONDYLITIS—Inflammation of a Vertebra. *See* CARIES OF THE SPINE.

SPONGE-GRAFTING. *See* GRAFTING.

SPRAIN.—The textures liable to this injury are ligaments, muscles, and tendons. As ligaments are mostly situated round joints, we usually speak of the latter as the parts injured. Those joints least liable to dislocation are most liable to sprain, and *vice versa*. The joints most commonly sprained (in order of frequency) are the ankle, wrist, and knee.

Pathology.—A sprain is something more than the name implies. There is always more or less of rupture of fibres, blood-vessels, and sometimes of nerves. A sprain may be defined as a wrench of a joint, causing rupture of ligamentous structure without dislocation of the bones.

Symptoms and Diagnosis.—In order to describe the symptoms, sprain of the ankle may be taken as an example. The patient, in running, walking, or jumping, slips his foot, or comes down on the outer edge of it, so that it is forcibly *inverted*. (This is the most common method of infliction of the injury, because *eversion* is liable to produce Pott's fracture of the fibula.) The patient feels a sudden pain on the outer side of the foot; he may be conscious of something giving way (which would probably be the external lateral ligament); he may become sick or faint, and will probably fall to the ground. The ankle will swell at once, and the foot will be incapable of bearing the weight of the body. A person under the influence of excitement, or with a slight sprain, may be able to walk some distance, but soon the foot will become too painful for progression. Swelling comes on very rapidly, and is due at first to effusion of the blood and serum into the cellular tissue round the joint. There may also be effusion into the joint itself in severe cases. After a few hours, discoloration begins to take place from the effused blood, and it is astonishing how quickly the ecchymosis appears in some cases.

Certain complications which may occur will affect these symptoms. If the synovial membrane of the joint is injured, there will be effusion of blood and serum into the joint, as already mentioned, and, perhaps, subsequently synovitis. A blood-vessel of some size may be torn, when there will be considerable effusion of blood throughout the cellular tissue; or a nerve may be injured, when there will be severe pain, or numbness and powerlessness, of the parts beyond. Rupture of a tendon or muscle will also aggravate the symptoms. If a bone is broken, there will be crepitus, &c., and the case will become one of fracture complicated with sprain. If there is

dislocation of the joint, the deformity which results should be a sufficient guide in forming a diagnosis. In all cases of difficulty the position of the osseous prominences, and the presence or absence of deformity and crepitus, should be sufficient to decide by.

Treatment.—The writer has been in the habit of describing the treatment of sprains under four heads, viz: cold, heat, pressure, and massage.

1. Cold. If the case is seen early, cold water, or, better still, pounded ice in a waterproof bag, kept constantly applied, will prevent swelling and effusion, will favour the absorption of the blood already extravasated, will relieve pain, and will prevent inflammation. The secret of success in applying this method is to keep up the cold without any intermission. Two or three days of this treatment may be sufficient to let the patient get up and go about with a bandage on.

2. Heat. If considerable swelling has occurred, and some time elapsed before the patient is seen, then hot fomentations are very soothing. Absolute rest and warm applications having been maintained for some days, treatment by pressure or massage may be resorted to, in order to hasten the cure.

3. Pressure. This method may be employed at any stage of the treatment of a case of sprain. After some days of cold or hot applications, a firm bandage, wet or dry, or, better, carefully applied straps of adhesive plaster, will afford support to the weakened limb, and will promote the absorption of the effused blood and serum. But the way in which pressure is most beneficial is when applied at the very first. It then *prevents* swelling and effusion, and, if combined with some immovable apparatus, as lateral splints with starch bandaging, or plaster of Paris, the patient may be able to go about. The great point in employing this method is to apply the bandage *evenly*, with no undue pressure at any point. The following is a safe and comfortable apparatus:—Let two pieces of thick flannel be cut the shape of the foot and ankle (or wrist), large enough to meet behind and in front (they had better be double for the ankle). These should be soaked in a thin mixture of plaster of Paris, and firmly and evenly bandaged on. When they have set, which they will do in a few minutes, they may be removed, padded, if necessary, and re-applied.

4. Massage. This method consists, as is well known, of a combination of rubbing,

kneading, and movement of the part. *See* MASSAGE. Such procedure is, of course, totally opposed to the principle of *rest*. The theory of its beneficial action is that it promotes absorption, and prevents adhesions and contractions. Massage is useful in two ways. It may be employed from the first in slight sprains, and in severer ones is very beneficial, if employed after a week or ten days, in restoring the injured parts to their natural appearance and functions.

After-treatment and Results.—It should never be forgotten that there is truth in the popular saying that a neglected sprain is worse than a broken bone. When one remembers what structures are torn, one easily sees how their non-union or improper union will leave a permanently weakened or disabled limb. It comes to be an important question, therefore, 'how long ought treatment of a sprain to be continued?' The writer would say that for a severe sprain three weeks of rest will be necessary. But the best guide, which will apply to all cases, is disappearance of all swelling, and capability of moving the joint freely without pain. If these indications are fulfilled, then there can be no difficulty in pronouncing the patient cured, and the limb fit for use. But, unfortunately, such a result is not always obtained; even after several weeks of treatment, the joint may be swollen and stiff, or painful and weak. This is usually the result of one of two things—either the joint has been kept too long stiff, or the patient has been using it too much. In either case, a course of massage is usually beneficial, combined with warm or salt-water bathing. But there are other more serious and permanent results that may follow a badly-treated sprain. A *ganglion* may appear, connected with a tendon-sheath or a joint, and associated with permanent weakness of the part. A more serious event is the occurrence of disease of the joint. The history of a scrofulous joint often commences with a severe sprain.

A. G. MILLER.

STAFF. *See* LITHOTOMY; BOUTONNIÈRE, the Operation of; BUCHANAN'S RECTANGULAR STAFF.

STAPHYLOMA. *See* CORNEA, Variations of Curvature of the.

STAPHYLORRHAPHY. *See* CLEFT PALATE, The Surgical Treatment of.

STASIS. *See* INFLAMMATION.

STEATORRHEA. *See* SEBORRHEA.

STERILITY IN THE MALE.—An incapacity for procreation. It may be the result of absence of spermatozoa from the seminal fluid, or of absence of any seminal discharge during coition. The former is designated Azoospermism, the latter Aspermatism.

Temporary azoospermism is sometimes caused in persons of naturally feeble power by excessive indulgence in venery or by masturbation. Abstinence from all erotic excitement speedily restores the functional activity of the glands in these cases.

Idiopathic azoospermism is a very rare affection. It occurs in young and vigorous adults, in whom no physical defect can be discovered. They have all the external signs of virility, can copulate and have emissions with the normal pleasurable sensations, but the seminal fluid never contains spermatozoa. The writer has recently had under his care an instance of this affection. A gentleman aged 40, vigorous and healthy, had been married for several years but had no children. His sexual appetite was normal, and coition was always attended with an abundant ejaculation and normal sensations. His testicles were large, firm, and sensitive to pressure, and no abnormality could be discovered in the efferent passages. He had never had epididymitis. His semen, examined on three occasions, with an interval of some months between each examination, was always devoid of spermatozoa. It was perfectly normal in appearance, but microscopically disclosed many epithelial scales, molecular fat, and crystals of triple phosphates. No explanation of this condition has as yet been discovered.

Usually azoospermism is due to defect or disease of the testicles, or to obstruction of their efferent ducts. Atrophy of both glands, from accident, disease, or mal-nutrition, must produce this condition. Cryptorchism has generally the like result. Cases have been recorded of apparently successful procreation by the subjects of bilateral cryptorchism. But in the absence of microscopic demonstration of spermatozoa in the semen of such persons, or of dissection disclosing a normal condition of the glands, some doubt must be entertained, for the examination of such retained testicles has almost invariably revealed an absence of the ordinary glandular structure.

Obstruction of the efferent ducts will also cause azoospermism. This may be congenital, but is more usually the result

of gonorrhœal epididymitis or of tubercular deposits. Sometimes tumours of the prostate gland may cause obstruction of the vasa efferentia before their junction with the vesiculæ seminales. Aspermatism may be caused by some obstacle to the discharge of the seminal fluid, or may be of nervous origin. Very tight phimosis, or a very small urethral orifice, such as usually exists in intermediate cases of hypospadias, where the urethra opens on the under surface of the penis and a little behind the glans, may produce retention of the seminal fluid. Urethral strictures may have the like result, even when no difficulty in micturition has been experienced. If the stricture be situated anteriorly, the semen is retained in the urethra and voided after erection has subsided; but if the stricture be far back the semen usually passes into the bladder, and spermatozoa are found in the urine. But the obstacle may be in the ejaculatory ducts, when there will be either no discharge whatever during coition, or only the scanty secretion of the prostatic, Cowperian, and urethral glands. Cicatricial formations in the prostate, resulting from inflammation or suppuration or prostatic calculi, may produce this condition. Lateral lithotomy is said to sometimes have the same result.

But aspermatism may be of nervous origin. As ejaculation is a reflex act, so the afferent or efferent nerves or the nerve-centre may be the cause of failure. Thus, deficient sensibility in the glans penis, from cicatrices or induration, has sometimes caused it. Sometimes there is a history of incontinence of urine in childhood, which suggests the possibility of some atonic condition of the muscular apparatus for ejaculation. As physiology has not yet demonstrated the existence of a distinct ejaculatory centre, the pathological affections of it, if any such exist, are unknown.

But aspermatism may be of psychological origin. This form may be permanent or temporary, complete or partial. Some persons are said to have had sexual desire and erections, but never to have had ejaculations while they were awake, while during sleep they have had abundant emissions of normal semen. Such cases can only be explained by the assumption of some inhibiting psychological influence. Minor degrees of this have been described where the inability was limited to intercourse with one individual, or was only of temporary duration.

Treatment.—Azoospermism, unless as the temporary result of exhaustion of the glands from excessive venery, is practically incurable in the great majority of cases.

Hence, acute inflammation of the testicles or epididymis, and syphilitic orchitis should be promptly and suitably treated, for speedy resolution of the inflammation and absorption of the syphilitic deposit afford the best chance of functional recovery of the glands and maintenance of permeability in the efferent ducts. Aspermatism due to phimosis or stricture may be cured by circumcision and dilatation. Obstruction of the ejaculatory ducts is not amenable to treatment, but nature sometimes bursts open the opposing barrier during coition. When the sensibility of the glans penis is deficient, blistering the part and galvanism have been of service in some cases, but have been ineffectual in others. In atonic aspermatism the extract of *nux vomica* or Easton's syrup is useful. The psychological variety of aspermatism occurs so rarely that little is known about it. Possibly the repeated application of the constant current to the lower part of the spine and neck of the bladder might prove useful. JEREMIAH M'CARTHY.

STERNUM, Fracture of the.—Fracture of this bone by itself is of exceedingly rare occurrence, but it is more common when associated with that of other bones, as of the ribs or spine, especially in accidents of a crushing or compressing nature. It is also said to be produced occasionally by muscular action, as in the straining of parturition, when the patients have arched their bodies strongly backwards in the act of delivery. Fracture of the bone may also be produced by bending the body, either backwards or forwards, over a projecting angle. In the former case, the fracture is produced by indirect violence; the parts of the sternum getting torn asunder by the strain put upon them. In the latter case, the injury may be either produced by the direct action of the projecting angle, or the sternum may get so doubled in on itself as to break.

Fractures of the sternum may be either transverse, oblique, or longitudinal. Of these, the two former are by far the most common. The so-called dislocations of the sternum may be most fitly considered here with the fractures of this bone,—the signs of the lesion, the symptoms following it, and the effects being similar in the two cases. The only dislocation of the sternum at all frequently seen is that between the manubrium and the gladiolus, and even this is not common.

The causes producing both fracture and dislocation are the same. There is generally considerable deformity, produced by the overlapping of one fragment upon the other.

The lower fragment is generally found to be the one most in front. Reduction of the deformity is most difficult, though it has been accomplished by manipulation in a few cases. If the surgeon should be successful in this, the attempt may be made to keep the fragments in position by pads, strapping, and bandages. It will, however, generally be found that the effort is futile, the deformity being reproduced on a change in the patient's position.

Other symptoms of these lesions will consist in pain at the seat of separation, increased by efforts at respiration, especially those of the forced kind, such as sneezing or coughing. These injuries to the sternum are frequently complicated by laceration of the pericardium or pleura. In such cases, the symptoms will be those of the more important injury, and will be found treated of in the articles PERICARDIUM, Wounds of the; LUNG, Wounds of the; HÆMOTHORAX, &c.

The prognosis in an uncomplicated case of fracture or dislocation of the sternum is very favourable. In complicated cases the mortality is high, and the prognosis will depend upon the organ injured.

H. G. HOWSE.

STINGS OF INSECTS.—In this country, the stings of bees and wasps, and in tropical countries, besides these, the bites of spiders, centipedes, and scorpions may be attended by unpleasant consequences.

BEES AND WASPS.—As a rule, nothing more than local swelling and pain follow the introduction of the poison, and the severity of these effects depends a good deal upon the general condition of the individual. The sting sometimes remains in the wound, and must be extracted. This and the local application of some cooling lotion or powder are usually all that is necessary. The sting of the bee will sometimes give rise to serious general symptoms, and even prove fatal; but it appears, from a study of several cases, that these unusual results are determined largely by a predisposition on the part of the individual. In two cases, of which one proved fatal, it is noted that the ordinary local swelling did not occur, and, as both patients had frequently been stung before with the usual local effects, it is suggested that the poison entered a vein directly. The poison, when it produces a general effect, does so within a few minutes, leading to faintness, vomiting, diarrhoea, dyspnoea, and unconsciousness. Recovery may take place in an hour, or the patient may remain feeble for days, or death may result from

cardiac failure. When the sting is inflicted in the mouth or pharynx, there is danger from cedema of the glottis. Such a result, ending fatally four hours after the injury, is recorded as occurring in a man aged twenty-four.

SPIDERS.—The bite of the katipo or poison spider, of New Zealand, is the most serious in its effects. A local swelling of large size and of a white colour is produced; the patient in one case became faint and pulseless, cold and flaccid, but rallied after the free use of ammonia and brandy. The most peculiar effect of the poison appears to be the production of a low and feeble state of health, which may continue for six weeks or three months. The spider has a dark glossy body, with a marked red spot on its back. Another variety without the red spot is also described. The insects inhabit the sandy beaches, and shelter amongst the drift-wood and sedge.

CENTIPEDES AND SCORPIONS have special hooks for purposes of attack, connected in the former with the mandibles, and in the latter with the terminal abdominal segment. Only the bites of the larger centipedes are serious, and the effect seems to be purely local, so that probably no poison is introduced. The hooks of the scorpion are perforated and connected with poison-glands, and the symptoms resemble those described as occasionally following the stings of bees—viz. numbness, vertigo, vomiting, &c. Locally there is acute swelling, followed in many cases by supuration, sloughing, and their consequences.

Treatment.—The local and general effects being much the same in all, the treatment also will be similar. Where possible, a ligature should be tightly applied above the wound, the puncture sucked or otherwise treated, and afterwards the ligature slowly relaxed, constitutional treatment being employed as symptoms develop. Locally, the application of cold at first, and, if inflammation occur, of warmth by means of poultices, &c. In the case of spiders, a crucial incision has been made with good effect, and afterwards a strong antiseptic might be applied. Freestimulation by means of ammonia and alcohol should immediately be resorted to in cases where there is any faintness, and their timely administration has no doubt saved many patients, for the effect of the poison, in the majority of instances, is of short duration.

CHARTERS J. SYMONDS.

STOMACH, Cancer of, and Treatment.
See GASTROSTOMY; PYLORUS, Operations on the.

STOMATITIS.—The inflammatory lesions which may affect the mouth are as follows—(1) catarrhal; (2) follicular; (3) aphthous; (4) ulcerative; (5) gangrenous; (6) mercurial; (7) parasitic, and (8) syphilitic stomatitis.

1. **CATARRHAL STOMATITIS.**—*Causes.*—*a.* Dentition. The disease is most common during the period of eruption of the milk teeth, between the ages of six months and two years, but may also appear in connection with the second dentition, between the ages of six and thirteen years, or even in early adult life, at the time of the eruption of the wisdom teeth.

β. Local irritants. Improper food, abuse of alcohol or tobacco, carious teeth, accumulation of tartar, &c.

γ. Disturbances of the digestive tract, primary or in association with general disease. In this case the complaint seldom falls under the notice of the surgeon, unless the causative condition be masked by the local lesion.

Symptoms.—The onset is marked by a temporary diminution of the secretions of the mouth, while the mucous membrane becomes dry, hot, and tumid, and is beset with bright red patches which quickly spread, and by coalescence form a diffused blush over the whole of the cavity. The saliva is scanty and tenacious, the sense of taste is vitiated or lost, mastication and deglutition are painful, the breath becomes offensive owing to decomposition of the secretions, and the patient may be annoyed by subjective gustatory sensations of a more or less disagreeable nature. At the end of a few hours, the secretions are restored and soon become excessive; the mucous membrane becomes redder and more swollen, and presents deep indentations at the points of contact with the teeth; the epithelium becomes thickened and cloudy in places, and may here be detached, leaving superficial erosions; and finally, in severe cases the borders of the gums may ulcerate and the teeth become loosened. The course of the disease is usually mild, the symptoms passing away within a few days; but occasionally it may defy treatment for several months.

Treatment.—It is seldom necessary to adopt any special treatment for the milder forms of the disease, beyond attention to the probable cause and to the regulation of diet. In the more severe cases, the use of detergent washes (chlorate of potash, borax, &c.), ice to suck, and the administration of bark and other tonics, will hasten the progress of recovery. In the rare examples

of chronicity, perchloride of iron in large doses (one to three drachms three or four times daily) may be found efficacious.

2. **FOLLICULAR STOMATITIS** is marked by an eruption of red papules surrounded by inflammatory areolæ, and developing apparently in connection with the mucous glands of the lips and cheek. The points generally soften and burst, leaving small excoriations, which soon heal.

3. **APHTHOUS STOMATITIS** is a disease that offers a certain resemblance to the parasitic stomatitis or 'thrush,' both in appearance and course, but is less superficial and does not present the same fungus on microscopical examination. It is characterised by the appearance of disseminated whitish or yellow patches of sub-epithelial exudation, which give place to superficial excoriations, and it may be associated with febrile disturbance, and in some cases with vomiting, diarrhoea, and other manifestations of digestive disorder. This and the last variety of stomatitis usually appear under the same circumstances as the ordinary catarrhal form, and are amenable to the same treatment.

4. **ULCERATIVE STOMATITIS.**—This is a more specific and troublesome affection than the catarrhal form, and is marked by a fairly definite localisation of its principal lesions, and an almost absolute limitation to two eras of life.

Etiology.—The causes are twofold: on the one hand, *constitutional debility* mainly induced by impure air and improper or insufficient food; and on the other, *local irritation* in association with the eruption of the permanent teeth. It is, hence, almost peculiar to the children of the poor between the ages of six and twelve, or to young men between eighteen and twenty-five who are placed under unfavourable hygienic conditions, as in barracks, hospitals, &c. In either case it may assume an epidemic form, but there is no satisfactory proof that it spreads by contagion.

Symptoms.—The earliest sign is, usually, a fetor of the breath with a sense of heat and tenderness of the gums. The saliva is at first diminished in quantity, but soon becomes profuse, opaque, and offensive. The whole of the buccal membrane becomes red, swollen, and hyperæsthetic, the gums are exquisitely sensitive and bleed at the slightest touch, the teeth loosen, the submaxillary and sublingual glands become enlarged and slightly tender, and the movements of the jaw are so painful that mastication becomes intolerable. On examination of the mouth, the affection is found

in most cases to be unilateral (more frequently attacking the left side), the gums are dusky red or purple, swollen, ulcerated, especially where in contact with the molars, and covered with a greyish pultaceous material consisting of epithelial debris and altered secretion admixed with pus and blood, and containing countless bacilli. The mucous surface of the cheek, opposite to the ulcerated gums, usually presents a whitish oval patch of altered epithelium or an ulcer left by the detachment of the morbid tissue, and this lesion may become continuous with that of the gum by meeting it near the last molar tooth. The tongue, in like manner, may present a white patch or a superficial ulcer opposite to the same point; and, lastly, disseminated areas of a similar character may appear upon the palate, pillars of the fauces, and tonsils, where they may possibly be mistaken for mucous tubercles. It must be noted that the ulceration is not associated with inflammatory induration of the contiguous tissues, as in *cancrum oris*.

The course of the disease is usually favourable under treatment, but in very severe cases it may end as in *Mercurial Stomatitis*.

Treatment.—The essentials for recovery are pure air and good food. The diet should be in a fluid form, as nutritious and assimilable as possible, and may be carried to the back of the pharynx through a tube, if direct contact with the mouth induce much suffering. Pancreatic emulsion is a useful adjunct in many cases, and other articles of food may be artificially digested before administration. Nutrient enemata may be employed where the demand for support is urgent, and sufficient nourishment cannot be introduced by the ordinary channel; tonics in the form of the preparations of bark and iron are often valuable. Local applications of nitrate of silver or powdered alum to ulcerated surfaces, and the frequent use of stimulant washes (chlorate of potash, 20 grains to the ounce, &c.), may be recommended. The mouth should always be cleaned after food.

5. GANGRENOUS STOMATITIS. See CANCRUM ORIS.

6. MERCURIAL STOMATITIS.—This once common disease is now rarely seen in its more acute forms. It may occur, as heretofore, during the administration of mercurial preparations, especially where there is any natural or acquired susceptibility to the action of the drug; or in connection with industries involving frequent contact with the metal; but the exercise of more ade-

quate precautions in the latter case, and the influence of therapeutic progress in the former, have almost transferred the complaint to the list of pathological curiosities.

Symptoms.—The onset of mercurial 'salivation' is usually announced by a dry burning sensation in the mouth, a nauseous metallic taste, tenderness of the gums, and fetor of the breath. The salivary secretion soon becomes increased, and may at length pour from the mouth in immense quantity, even to the amount of several pints in the course of twenty-four hours; the fluid is thin and offensive, and the presence of mercury may be detected in it by chemical tests. The gums swell, assume a purplish tint, and may ulcerate; the teeth become loose and tender, and coated with a greyish pultaceous material of repulsive odour; the whole buccal membrane becomes inflamed, and covered with whitish patches of proliferating epithelium. The salivary glands and the submaxillary and retromaxillary lymphatic glands enlarge, and the swollen tongue may protrude from the mouth. Extension to the Eustachian tube may induce deafness, and the implication of the arytæno-epiglottidean folds may give rise to suffocative symptoms. Finally, the inflammatory processes may assume a destructive character, leading to extensive gangrene of the mucous membrane; and at length the patient, worn out by suffering and imperfect nutrition, sinks into fatal adynamia.

The duration of the disease is very variable even under the most active treatment. In ordinary cases a cure may be effected within a few days, but occasionally the resources of the surgeon are baffled for weeks.

Treatment.—The general principles of treatment are the same as in ulcerative stomatitis. The most active remedy in the mercurial form is chlorate of potash, which often exerts an almost magical influence over the local lesions. It may be used in the form of lotion (20–30 grains to the ounce), and given internally in association with hydrochloric acid and bark. Sulphurous baths have been recommended, with a view to hasten the elimination of the poison from the system.

7. PARASITIC STOMATITIS or THRUSH is a disease caused by the growth of a fungus, called the *oidium albicans*, in the buccal epithelium. It seldom appears as an independent affection, but more often arises as a complication in the later stages of chronic exhaustive maladies.

It commences with the appearance of little whitish spots upon a reddened base

about the angles of the mouth; these enlarge and coalesce to form milk-white superficial patches of considerable extent, which may eventually spread over the whole buccal cavity and the passages communicating with it. If the complaint be a symptomatic development in the course of other diseases, no special changes are observed in the pre-existing constitutional symptoms; but where it arises *de novo* it is usually preceded by febrile disturbance, and may be accompanied by vomiting, diarrhoea, and other signs of disorder in the digestive tract.

The patches, on examination, are found to consist of epithelium permeated by the spores and filaments of the fungus.

The general *treatment* is directed to the improvement of health and the relief of any digestive disturbance that may be present. Nitric acid is of value as a tonic. As local applications, glycerine of borax, powdered alum, and chlorate of potash are the most serviceable medicaments.

8. SYPHILITIC STOMATITIS.—The syphilitic lesions of the mouth are—(1) those of the early secondary period, a transient erythema, mucous tubercles, and superficial sores resulting from the latter; and (2) the gummatous infiltrations of the later stages, which tend to break down into ulcers. The affections may assume special characters in the TONGUE and PALATE.

An erythema of the mouth and throat is commonly associated with the earliest cutaneous eruption, but is generally of trifling severity and short duration, and calls for no special treatment.

Mucous tubercles show themselves in the early months of the disease. They appear as flat or slightly prominent opaque greyish patches, which by detachment of the affected epithelium may become converted into irregular excoriations. The angles of the mouth, the tongue, tonsils, and pillars of the fauces are the most frequent points of attack, but the lesion may involve any portion of the buccal membrane. See MUCOUS PATCHES.

This affection, so quickly amenable to treatment in most other situations, is apt to be excessively obstinate when established in the mouth, probably owing to the irritation kept up by the normal and abnormal secretions, by the passage of food, and by the constant movements of the affected part in speech, mastication, and deglutition. The best local measures of treatment are cleanliness, careful selection of diet, and the occasional application of nitrate of silver in stick or solution.

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The gummatous infiltrations may be roughly divided into 'superficial' and 'deep'; the former confined to the mucous membrane, the latter extending into the subjacent tissues. In either case the lesion, as a rule, is primarily manifested by a tubercular prominence, but may sometimes assume a more diffused character, as in the 'sclerous glossitis' of Fournier. See TONGUE, Diseases of the.

The gummata are always destructive in tendency, and may lead to deep ulceration in the soft parts, or to necrosis where the bony walls of the mouth are attacked, and leave permanent and often unsightly scars.

The *diagnosis* of syphilitic ulcers of the mouth is of more particular interest when the tongue is the seat of disease, but the distinction of the specific lesion from non-specific ulcerations and from epithelioma must be borne in mind, in the investigation of all parts of the cavity.

The characters of ulcerative stomatitis and tubercular sores have been dealt with elsewhere and should offer no difficulties of diagnosis, but it is sometimes by no means easy to arrive at the far more important decision between malignant and gummatous ulcers. As a rule, the tertiary ulcer is marked by the absence of glandular enlargement, the comparatively slight induration of its base and borders, relative freedom from pain, its frequent localisation in situations not exposed to direct irritation by carious teeth, &c., and by the age and history of the patient. But age, history, and locality in certain cases fail to afford any guiding indications. A syphilitic sore is occasionally painful and indurated, and there may be some irritative enlargement of the submaxillary glands; while, on the other hand, an epithelioma in its early stages may cause no suffering, and may be long unassociated with any perceptible glandular implication. In cases of doubt, the examination of a fragment taken from the surface of the ulcer, and the tentative administration of rapidly increasing doses of iodide of potassium, will often provide a solution to the problem; or the sore may be scraped with a curette, a plan that may enable the surgeon to arrive at a positive conclusion without prejudice to further treatment. It must, however, be remembered that a syphilitic lesion is a not infrequent nidus for the development of malignant disease, and that it is hence unadvisable to temporise too long with a suspicious ulcer that resists all the appropriate treatment for the milder affection.

The constitutional treatment of the later syphilitic diseases of the mouth is that of SYPHILIS in general. Locally, there is little to be done beyond the exercise of the precautions mentioned in connection with mucous tubercles.

WILLIAM ANDERSON.

STONE IN THE FEMALE BLADDER.—Stone is much less frequent in the female than in the male, the proportion in the Norwich Hospital being about 1 to 19. It is usually of phosphatic structure, and its nucleus is often formed by some foreign body, such as a hairpin, a portion of catheter, or of bone or vegetable substance. Sometimes it attains a very large size, and has been known to interfere seriously with parturition. When small, the calculus may escape unnoticed by the urethra, and sometimes it is discharged by vaginal ulceration. In the museum of the Norwich Hospital there is a collection of 3,000 calculi, which were passed by a lady during three years and a half. In the same collection there is also a stone weighing six ounces, which was spontaneously extruded from the female bladder.

The *symptoms* are similar to those of stone in the male bladder, and the diagnosis is seldom attended with any difficulty. Exploration should be made with a short and almost straight sound, or with an ordinary female catheter. In cases of difficulty, the finger should be placed in the vagina and, at the same time, pressure be made to bear upon the bladder above the pubes. The stone, if large, may often be thus detected.

The usual methods of treatment are dilatation of the urethra, lithotrity, and lithotomy.

DILATATION.—The female urethra may be readily dilated by Weiss's three-bladed dilator, or by gently introducing the little finger, or a large sound or bougie. Gradual dilatation of the canal may be effected by the use of a sponge-tent or a stem of laminaria, but it has been found that the rapid method is less liable to be followed by incontinence of urine. A suitable pair of forceps is then introduced, and the stone extracted. Dilatation may be assisted by incision of the mucous membrane of the urethra. Except in cases of very small stone, dilatation, with or without operation, cannot be considered a suitable operation, as it so often results in incurable incontinence, due either to over-distension of the urethral walls or of the sphincter of the bladder.

LITHOTRITY is the most satisfactory operation in cases of stone in the female bladder, since calculi may be crushed or removed at one sitting at least as readily as in the male subject, if not more so, and the convalescence, as a rule, is more steady, certain, and rapid. The objection to this operation that it is difficult to inject much fluid into the female bladder has, at the present day, lost much of its importance. By the use of a short and specially devised lithotrite, a stone of moderate size may be readily seized and crushed into small fragments, which can either be removed at once by forceps or by a suction apparatus, or be left for expulsion in the stream of urine, which is more free and forcible in the female than in the male.

LITHOTOMY.—The stone may be removed by making an incision through the floor of the urethra on a grooved staff (urethral lithotomy), or more directly through the anterior wall of the vagina (vaginal lithotomy), the edges of the wound in each case being brought together by fine metallic sutures, and a catheter being retained in the bladder. The chief risk of lithotomy in the female, whether urethral or vaginal, is failure of union between the edges of the wound and consequent formation of a fistula. The operation, though much less formidable than lithotomy in the male, is not indicated except in cases of large and hard stones that cannot be crushed.

If the stone be very large, so as to occupy most of the cavity of the bladder, the only method of operative treatment likely to prove successful would be supra-pubic lithotomy, the difficulties and dangers of which might be much diminished by attention to antiseptic details and by distension of the vagina. See LITHOTOMY. T. W. CROSSE.

STONE IN THE MALE BLADDER. The children of the poor, and elderly members of the well-to-do classes, are the chief sufferers from vesical calculus; it is seldom found in children of parents in comfortable circumstances, and rich men are more prone to the disease than poor men. Before discussing the special symptoms of stone, it may be remarked that it is very suggestive of the presence of a calculus in the bladder, if the patient who complains of painful and frequent micturition has previously passed a number of stones, and now congratulates himself that he cannot be suffering from a calculus, since he has passed none for some time.

Symptoms.—1. *Pain.*—This is usually the most prominent symptom. The patient

complains of pain in passing water. It is most severe at the close of micturition, when the bladder is empty, and is usually felt at the end of the penis, about an inch from the external meatus. The pain disappears as urine gradually collects again in the bladder, and separates the stone from the sensitive walls of that organ. It is described as a shooting, throbbing or aching pain, and is accompanied by much involuntary straining in which the rectum often participates, causing the evacuation of its fecal contents, or the protrusion of piles if any exist. Pain is felt if the patient is jolted over a rough road, or shaken in any way. Riding on horseback often causes the first symptoms noticed, and brings the sufferer to the surgeon. Stooping is often found to cause pain.

2. *Blood in the Urine* is generally the next symptom which attracts notice. After exercise, especially, the urine is likely to be tinged with blood. Sometimes the urine is passed apparently free from blood to the naked eye, until the final part of the stream, which may be red; and at the very last a drop or two of pure blood may pass. The hæmaturia comes on gradually. Sudden and well-marked hæmaturia is not characteristic of stone. Rest generally causes bleeding due to stone to disappear.

3. *Frequency of Micturition*.—As a rule urine has to be passed oftener than usual. When moving about, the patient finds he has to make water more frequently than when sitting quietly in his easy-chair. When in bed at night, micturition is less frequent than in the day-time. If these facts are elicited, they will be strong evidence of the presence of stone in the bladder.

4. *Sudden stoppage in the flow of Urine*.—This symptom is mentioned in most books on stone, and is, therefore, referred to here, but it is in reality rarely observed. When it does occur, the stoppage is due to the stone getting into, or falling over, the vesical orifice of the urethra.

5. *'Attacks of the Stone.'*—The bladder may carry a large stone without producing many symptoms, because the calculus has made a nest for itself from which it rarely moves. When, however, it is disturbed, as after unusual exercise or shaking, severe symptoms may suddenly appear. There will be frequent desire to pass water, accompanied by straining and much pain, and the urine will contain blood and mucus. Such a condition is called 'an attack of the stone.' Rest and fomentations generally suffice to make these symptoms disappear

for a time, only to return with increased vigour when fresh provocation is given.

6. *Condition of the Urine*.—The urine is usually cloudy from muco-pus; but perfectly clear urine is not incompatible with the presence of a large stone in the bladder.

In boys the symptoms are much as just described. Micturition is painful, and the child cries and tries to relieve his suffering by pulling at his foreskin, which is long and reddened from constant manipulation. The right thumb and forefinger may be found in a sodden condition from their frequent contact with urine. The bowel is constantly protruded, and genuine prolapse of the rectum is not uncommon.

Differential Diagnosis of Vesical Calculus.—The symptoms of stone in the bladder must be distinguished from those of many of the diseases of the urethra, prostate, bladder, and kidney. In stricture of the urethra, any pain there may be in passing water is during the act and not afterwards. In hypertrophy of the prostate, pain is felt before water is made. In tumours of the bladder, the bleeding is more profuse than when caused by stone. Portions of tumour-débris may also be detected by the microscope in the urine. Tubercle or calculus of the kidney can only be diagnosed by a process of exclusion, after an instrumental examination has been made. It may be accepted, as an axiom, that no surgeon can say, from a patient's symptoms, whether or not he has a stone in his bladder without sounding him; and it may be added, no patient should be sounded for stone unless he has at least some of the symptoms, or until the following simple physical examinations have been made.

Passage of a Catheter.—After the patient has made all the urine he can by his own efforts, a soft catheter is immediately introduced. The instrument will at once detect any stricture of the urethra or calculus in that canal. If atony or paralysis of the bladder exists, a large quantity of retained urine may be drawn off, while, if there is a stone in the bladder, the operator will often be able to form a shrewd suspicion of its presence by experiencing a grating sensation as the catheter leaves the bladder; and the probability of its presence will be much increased if there is a stain of blood at the meatus as the catheter comes away, and especially if the patient at that moment complains of pain.

Rectal Examination.—The introduction of the finger into the rectum will enable the surgeon to detect, at once, any abnormal

condition of the prostate. He will note the size of the organ, and, should it be enlarged, will determine the nature of the swelling. If the gland is acutely inflamed, it will be hot and exquisitely tender, and if abscess has formed, fluctuation will be sufficiently obvious. The finger in this position may also gather useful information as to the condition of the bladder; if that organ is full of habitually retained urine and no catheter has been passed, the distension will be readily felt. Any organic deposit in the wall of the bladder at its base will be also distinguished. During a rectal examination the vesiculæ seminales should always be defined; they are very likely to be enlarged from tubercular deposit if any other portion of the urinary tract is so affected. In boys, a vesical calculus is often easily felt by the finger in the rectum. Suprapubic pressure will aid a rectal examination.

Stone not infrequently exists in addition to one or more of all those complaints for which its symptoms may be mistaken, and sometimes stone is a direct consequence of certain of these diseases. See STRICTURE OF THE URETHRA; PROSTATIC HYPERTROPHY. But if a well-marked stricture is found, or an enlarged prostate, or atony, or paralysis of the bladder, the patient should be subjected to appropriate treatment, and sounding must be delayed, unless the symptoms of stone are very marked, in order to avoid aggravating these affections by instrumental disturbance. If treatment fails to relieve the symptoms, the case must be further investigated and the bladder sounded.

SOUNDING FOR STONE.—The operation consists in the surgeon introducing a metal rod into the bladder, and searching with it for the stone. He is not satisfied that a stone is there unless he feels it with the sound, and hears the characteristic 'click' made by the contact of his instrument. Sounding must never be hastily or lightly undertaken, for there are many instances on record of its having been followed by fatal results even in children, although they are much less susceptible to such interference than men. Sounding is, therefore, an operation which must be performed with every precaution and with extreme gentleness.

The sound consists of a cylinder of polished steel or of silver, about nine inches long, and in size equal to No. 7 of the English catheter scale. The final inch is curved at an angle of 120° to the shaft, forming a beak with its extremity smoothly rounded. The other end is fitted with a

handle, preferably cylindrical. A child's sound is of the same shape, but of course much smaller. A couple of sounds, one equal to No. 1 and one to No. 3, will suffice for all cases of children. A sound is quite unlike a metal catheter, with which it has nothing in common. No patient should be sounded with a metal catheter or catheter-shaped sound.

Simple as the operation of sounding may appear to the inexperienced, there is no minor operation in surgery more important, or requiring more delicacy, skill, and experience, for the possibilities of error are numerous.

Sounding a Child.—An anæsthetic should always be administered if possible. A sound of appropriate size is selected and used with gentleness. The mistake most likely to occur is that of not finding a stone when it is really there; the opposite mistake is not of common occurrence in the child's bladder, although contact of the sound with the bony prominence of the ischial spine has been taken to be contact with a stone.

Sounding a Man.—A patient should rarely be sounded unless he is prepared to rest quietly in a warm room for twenty-four hours afterwards. A railway journey, for example, taken immediately after being sounded, has not infrequently been followed by alarming illness (urinary fever), and sometimes by death. A minor accident after sounding is an attack of retention of urine, for which the surgeon must be prepared. An anæsthetic is rarely necessary. The surgeon should so plan his examination that there is not more than an ounce or two of urine in the bladder, or he may empty the bladder by means of a soft catheter, and inject an ounce of tepid water into the organ. The patient lies on his back upon a couch, with the head on a low pillow, the buttocks raised upon a pillow higher than that under the head, the knees flexed, the soles of the feet on the couch, and the thighs rotated outwards. The surgeon frees his own wrist from any jingling jewellery and, standing on the patient's right side, introduces the sound, which has been made absolutely clean, and has been lubricated with a little carbolised oil. As the beak of the sound enters the prostatic urethra, the instrument is gently rotated from side to side upon its long axis, in order that the beak may be lateralised right and left directly it enters the neck of the bladder, for it is here that most stones are found. Having searched the sides of the bladder and the upper fundus, the handle of

the sound should be depressed so as to raise the beak in the bladder; the beak should then be turned downwards and brought forwards to the neck of the bladder, sweeping the floor from side to side. In this way many a stone, which otherwise would have escaped detection, will be found lying behind and below the enlarged middle lobe of the prostate. All these movements should be slow; the too eager operator, by his energetic movements produces currents in the urine, which move a small stone about in such a way that it eludes the sound.

Contact with the stone having been obtained, it is very desirable to form an opinion as to its nature, size, and also whether there is more than one stone present. It is not unusual for an experienced hand to fall into error concerning these particulars. The sound of the instrument striking the stone is characteristic of the three chief kinds of calculus: the sound of an oxalate calculus is like that of a piece of iron; a uric acid stone sounds like a piece of marble, and a phosphatic calculus sounds and feels like a piece of mortar. By passing the sound to the extremity of the stone, and then tapping as the instrument is withdrawn, a very fair idea of the size of the calculus may be formed. The sound may be the means of forming an opinion as to whether there is more than one stone; but the certain method is to introduce a lithotrite, seize the stone, hold it tightly in the lithotrite, and use it and the instrument as a sound in searching for more stones. The larger the stone the fuller the ring of the sound upon it. Small stones of all kinds produce only a tinkling sound; when they are very small the sound is a mere tick. It is difficult to mistake an acid stone when once the sound has touched it, but the phosphatic calculus is not infrequently passed over as a mere sabulous condition of the mucous membrane.

The sources of error in sounding will now be discussed. There are few mistakes in surgery more annoying than to miss a stone, although it is an accident which may occur to the best surgeon. (Cheselden, the distinguished lithotomist, missed a stone in a case which is historical.) There are also few mistakes more terrible than to find a stone when in reality none exists. We will first consider how a stone may be missed, putting aside, of course, the possibility of a careless or clumsy hand, or a dull ear.

SOURCES OF ERROR IN SOUNDING.—*I. How a Stone is missed.*—1. The sound may not have passed into the bladder. A capacious prostatic urethra, or a prostate

hollowed by disease, may deceive the surgeon, and the actual cavity of the bladder may escape without examination.

2. A common mistake is to have too much urine in the bladder. A small stone in eight or ten ounces of urine is frequently difficult to catch.

3. Too much movement of the sound produces currents in the fluid contents of the bladder, which move the stone away from the instrument.

4. The sound is frequently allowed to pass the neck of the bladder without any rotation upon its long axis, so that the beak glides by and does not strike a stone lying close to the neck, the movements of the sound being confined to the superior fundus, where the stone is not likely to be. Of all mistakes, the writer believes this one to be the commonest.

5. The hypertrophied prostate may project like a hen's egg into the cavity of the bladder. There is of necessity below this projection a deep and narrow sulcus, in which a stone may lodge and defy detection by any ordinary examination. To find a stone so placed, the beak of the sound must be reversed directly it has entered the bladder, and the handle of the sound raised as much as possible. The forefinger passed into the rectum may facilitate the search.

6. A stone may have lodged in a sacculus or have become engaged between the fasciculi of an hypertrophied bladder, or it may be arrested at the opening of the ureter into the bladder, or may have become so covered by mucous membrane that a sound cannot easily reach it.

In the last case, it is perhaps generally more correct to say that the stone has been formed in a sacculus, which has only a minute aperture of communication with the bladder, so that for all practical purposes the calculus is covered by mucous membrane. Sacculated or semi-sacculated stones may therefore escape detection, until felt by the finger introduced by means of a perineal incision.

II. How a non-existent Stone may apparently be found.—1. Noises are produced by the patient's or surgeon's clothes and appendages, which may deceive the unwary; for instance, the ticking of a watch, the tinkling of jewellery, especially the surgeon's sleeve-links, the creaking of a boot, or the chink of money.

2. A well-oiled sound will often produce in the urethra a sucking noise, not unlike that of a small stone.

3. A vesical tumour may become covered with phosphates, and, especially if

pedunculated, will give a sensation very like that of a stone. In cases of real doubt the lithotrite will clear up the mystery.

4. A growth from the middle lobe of the prostate may practically form a vesical tumour, as under the last heading, and become coated with phosphates.

5. Vesical rugæ, if old and hard, may appear very like calculus; the sound may even elicit a dull note on striking them.

6. Phosphatic deposit may occur upon any portion of the vesical mucous membrane which is unhealthy.

7. Certain bony parts in the neighbourhood of the bladder, as, for example, the sacral promontory and the ischial spines, have, especially in the child, been mistaken for stone.

8. The bladder itself may beat upon the end of the sound, exactly as a bird's wing might be supposed to beat. This has been called 'the fluttering stroke of the bladder,' and is a well-recognised phenomenon. It can only deceive those who are unpractised in bladder-manipulations.

Many contrivances have been planned for intensifying the sound produced by the contact of an exploring sound with a vesical calculus. The microphone, sounding boards, and the lithophone, may be cited as examples. The lithophone consists simply of a rubber tube fixed into the operator's ear and attached at the other end to the sound; some may find such an instrument of assistance, but in reality a simple sound is the only instrument required in addition to a practised and sensitive hand and ear.

A stone having been found, the only question is which operation—lithotritry or lithotomy—shall be performed for its removal. All attempts at solution by medicines taken by the mouth or injections made into the bladder are useless, and generally worse than useless.

CHOICE OF OPERATION.—Lithotritry or lithotomy?

In the Boy.—Up to the present time, boys suffering from vesical calculus, with very few exceptions, have been always subjected to lithotomy, and with excellent results. Lithotritry has not been considered a suitable operation, owing to the unfitness of the child's bladder for the residence of fragments of stone, and the urethra for the expulsion of sharp-edged pieces. Now, however, that lithotritry at one sitting—by which is meant the crushing and complete evacuation of the calculus at a single operation—is accepted as yielding in the adult far better results than the older or many-sitting method, it is not unlikely that the

single-sitting operation may prove superior even to lithotomy in children; for, if efficiently carried out, lithotritry will no longer be open to the objections formerly urged against it. In this country, we have not at present evidence upon which to found a definite opinion upon the question; but, in India, lithotritry at one sitting has been performed with marked success upon a number of children. The surgeon may therefore choose for himself between lithotomy and lithotritry, if called upon to operate upon a boy; but, if inexperienced in lithotritry, he will perhaps do well to decide in favour of the former. *See LITHOTOMY.*

In the Man.—Here lithotritry is the rule, and lithotomy is becoming yearly more and more the exception. Lithotritry has always, *cæteris paribus*, been the safer proceeding, and now that the operation at a single sitting, with complete evacuation, has fully justified its claims to superiority over the older or many-sitting method, lithotritry for all practical purposes may be considered incomparably safer than lithotomy, and with rare exceptions it can always be performed. *See LITHOTRITY.*

There are four conditions in which lithotritry is contra-indicated: (1) *When the urethra is deformed*, owing to cicatrization after abscess from stricture, or mechanical injury, or even old hip-joint disease. In such cases, the urethra is often bound down by old adhesions, and is irregular from the existence of urinary fistulæ. A staff can be introduced after suitable attention and even operation, and lithotomy performed, but lithotritry will be impracticable unless the stone is very small (under an inch in diameter). Ordinary stricture of the urethra is no hindrance to lithotritry in experienced hands. An internal urethrotomy may be performed, or the stricture can be dilated. The writer's plan yields good results. He dilates the stricture while the patient is under the influence of ether, by passing in immediate succession a series of highly polished conical steel dilators, up to 16 (Eng.) Lithotritry is then performed, and the necessary instruments pass without special difficulty, which is not always the case if an incision has been made into the urethra, as in internal urethrotomy.

(2) *When the stone is very large.*—All stones may be said, in general terms, to be mechanically crushable; but the injury inflicted upon the bladder in crushing a uric acid stone of, say, three ounces in weight or two and a quarter inches in diameter, or a phosphatic stone a little larger, will be so

great that it will nearly always be safer to perform lithotomy.

(3) *When the stone is very hard.*—An oxalate stone of over an ounce in weight, or even a very large round uric acid calculus, may prove uncrushable by any ordinary lithotrite, and an instrument sufficiently powerful to break them will be so injurious to the urethra and bladder, that lithotrity must be set aside in favour of lithotomy.

(4) *When the nucleus of the stone consists of a foreign body incapable of being crushed.*—If the history of the case be distinct, lithotomy must be the operation selected.

Prostatic hypertrophy, atony and paralysis of the bladder do not interfere with the proper performance of lithotrity.

When lithotrity has been attempted and abandoned on account of one or more of the four contra-indications, the patient's chances of recovery will be much enhanced if lithotomy be performed at once. The case must necessarily be a severe one, and the mechanical interference with the urinary organs may cause such constitutional disturbance from urinary fever and cystitis, that the patient may die in a few days, without giving the surgeon another opportunity of operating, or at any rate a serious illness may cause considerable delay. It is therefore wise, whenever unusual difficulty is expected in the operation of lithotrity, to make preparation for, and obtain the patient's consent to the immediate performance of lithotomy, should lithotrity prove impossible. If lithotomy has to be performed, the selection of the method of cutting for the stone must very much depend upon the particular operator. The median method can only be required now for the removal of foreign bodies from the bladder, or in cases where the stone is not large, and lithotrity is only put aside on account of urethral deformity with perineal cicatrisation, the consequences of old-standing neglected urethral stricture. In cases of large stones, the choice is between lateral and suprapubic lithotomy. Dr. Petersen's method of distending the rectum with an air-bag and so pushing up the bladder, has rendered suprapubic lithotomy easy of performance, and apparently well adapted for the removal of large calculi; but further experience is required of this operation before a decided opinion can be given, and a comparison made between it and lateral lithotomy. See LITHOTOMY.

Is a patient with stone in his bladder to be left unrelieved by operation under any circumstances? A patient known to have

stone, but suffering little or no inconvenience from it, should never be advised or allowed to postpone operation beyond a very short period (a few weeks), because he can certainly never be in better health for operative procedure, and the stone, if retained, must gradually grow larger, and the operation for its removal become proportionally more formidable. There are, however, graver cases, where the patient is so worn by his sufferings, or by the presence of other disease, that the surgeon may well hesitate before subjecting him to an operation for stone. Are there *any* cases which should be left unrelieved by operation? This is a question which not infrequently has to be answered under circumstances of great anxiety, and the writer fully realises his responsibility in making the following remarks. From an extensive experience of many grave cases of stone in the bladder, he has no hesitation in saying that a patient with a stone in his bladder should almost invariably submit to an operation for its removal, however old or ill he may be. It is certain that if the stone is left it will destroy him, and not only that, but probably in the most agonizing manner. Death from stone in the bladder is generally preceded by prolonged torture, unless the patient is tolerant of, and susceptible to, opium, or unless uræmic coma mercifully comes to his aid. One of the exceptions to the rule here laid down must be the case where lithotrity is impossible, and the kidneys so extensively diseased that lithotomy may be expected to be immediately fatal. Cases, to all appearance most desperate, will often make astonishing recoveries if the stone is skilfully and entirely removed.

G. BUCKSTON BROWNE.

STONE IN THE URETHRA may be classified under two heads—1st, the acute; 2nd, the chronic. In the former, a calculus is passed down from the bladder, and, lodging in the urethra, causes more or less complete obstruction in the flow of urine. It may lodge anywhere in the canal, but as the meatus is the narrowest point of the passage, the most frequent site of impaction is the fossa navicularis. The penile urethra is the favourite site, from its greater proportionate length, greater amount of muscular spasm, and its numerous lacunæ. A not uncommon locality also is the membranous portion, just behind the anterior triangular ligament.

The stone is generally globular in shape, and seldom larger than a pea; but if permanent lodgment occur, with only partial

obstruction to the flow of urine, it loses its original shape and becomes elongated, resembling a date-stone; it then causes a certain amount of dilatation of the urethra, generally confined to one wall, a sacculus being formed, and thus allowing a fairly free passage for the urine. The tendency is for a stone to pass outwards towards the meatus, unless prevented by organic stricture, being in marked contrast to the opposite tendency of foreign bodies introduced into the urethra. These stones most frequently become impacted in children, on account of the small calibre of the urethra.

In the second class of cases, the symptoms are referable almost entirely to the primary complaint—stricture. Dilatation always takes place behind a stricture, and so forms a convenient receptacle for stagnant urine, which is favourable to the formation of calculous material or, what is more likely, its deposit on small stones or crystals passed from the bladder, which in a healthy urethra would have made their escape unnoticed. These cases occur almost invariably in adults, and the symptoms to which they give rise are but slight. The calculi may be of any kind found in the bladder, and when impacted they increase in size by deposit of the same material.

Symptoms of Impacted Stone.—While micturating, the patient suddenly feels intense pain; the urine which has been flowing freely as usual completely stops; violent straining ensues, which may dislodge the stone at once, especially if it come down in the first gush and there is a good head of water in the bladder to flush it through. Frequently this force is insufficient, and nothing but blood is expelled, and this is more common when the calculus is of irregular shape. The straining then passes off for a while, though great pain is complained of at the site of impaction and in the glans penis. After a while, the want to micturate is again urgent and straining re-ensues, which may force a little urine by the side of the stone if the obstruction be incomplete, and the urethra then becomes slowly accustomed to the presence of the stone; though severe pain is felt for a long time, and there is always a prospect of a complete block taking place if the stone be dislodged from its position.

Treatment.—Direct the patient to retain his water as long as possible, unless there be already complete retention; compress the glans penis between the finger and thumb, and tell him to try and micturate by straining as hard as possible; a

small round stone may be then easily dislodged, as the force of urine expands the whole passage and flushes it through. If these simple means fail, a stone in the penile urethra can generally be safely extracted by means of a fenestrated earscoop. If the stone be merely retained in the fossa navicularis by a tight meatus, this may be safely incised downwards towards the frænum. The small incision readily heals. If, however, the stone lies in the bulbous or membranous urethra, and there is little prospect of speedy removal through the meatus, a long fenestrated scoop may be applied. One form of scoop is made to bend over behind the stone by an internal screw, so as to secure a better hold, and there are endless varieties of long narrow forceps with joint and spring action, of every conceivable shape, their very number being a fair index of their inutility; these may be gently passed down the urethra, and an attempt made to grasp the stone, but great care must be used not to lacerate the mucous membrane in passing them or in seizing the stone. This little operation is most conveniently performed under anæsthetics. During this manipulation, digital pressure must be applied either in the perineum, or, if necessary, in the rectum, to prevent the stone being pushed back into the bladder. If the stone cannot be extracted, two courses are open: to push back the stone into the bladder, or to cut down upon it and extract it.

Here, the choice of the operation is determined by the age of the patient. In a child, it is best to open the perineum in the median line, the operator being guided either by feeling the stone, or by a straight staff passed down the urethra, and made to project into the perineum. A stone in the bulbous urethra can then be pushed out backwards; the bulb should not be incised, if possible, on account of hæmorrhage. In an adult, if attempts at extraction fail, the better procedure is to push the stone back into the bladder, this being best effected with a hollow-ended catheter. When the stone is fairly in the bladder, the operator can break it up at his leisure, or by slowly screwing down the lithotrite can compress it rather than break it, and so extract it practically entire.

Results of neglected Urethral Stone.—If retention be complete these are very grave. The first attempt at micturition being unsuccessful, the bladder remains for a time quiescent; but the distension soon gives rise to great pain, and repeated straining ensues, until at length the urethra is rup-

tured and the urine is forced into the surrounding cellular tissue. This for a time greatly relieves the bladder, but intense pain in the perineum soon sets in, with all the symptoms of extravasation of urine, and, unless free incisions be made at once, the constitutional disturbance and sloughing set up by the irritant action of the urine soon carry off the patient. See EXTRAVASATION OF URINE.

When the obstruction is slight, the stone may increase to an unlimited extent, forming for itself a pouch in the urethral wall, which gradually becomes absorbed by the irritation and inflammation set up. The stone thus gets to lie outside the urethra, and may slowly ulcerate its way out through the scrotum or perineum. This explains the curious fact that a catheter may be passed right into the bladder without feeling the stone, though it is known that a large one is present.

As an instance of the size which these stones may sometimes attain, it may be mentioned that the Norfolk and Norwich Hospital Museum contains a specimen of this class weighing eight ounces, which was removed from the scrotum. It consists of a central uric acid nucleus as large as a pea; around that some mixed urates and phosphates in an oval shape; the rest of the great mass of the stone is composed of dense white phosphates. T. W. CROSSE.

STRABISMUS.—CONVERGENT STRABISMUS (HYPERMETROPIC).—A very large majority of all cases of convergent strabismus are due to hypermetropia. The hypermetrope, in order to see clearly at any given distance, must make a greater accommodative effort than is normal for that distance; but, since accommodation and convergence always go together, this excessive effort tells also on the ciliary muscles; consequently the hypermetrope tends to converge for a nearer point than that at which he desires to look. If he cannot avoid an excess of convergence, he instinctively turns both eyes slightly towards one side or the other, so as to bring one eye to bear on the object while the other takes the whole deviation, and, as it were, squints for both. The majority of hypermetropes, however, do not squint, for the relation between corresponding degrees of accommodation and convergence is not absolute. With a given accommodative effort, it is possible to vary the angle of convergence to some extent. This does not necessarily disprove an anatomical association of the two functions; it may be, that a given effort of the centre for

convergence can be more or less neutralised by an opposing effort of the centre for divergence.

In slight degrees of hypermetropia, it is thus possible to preserve the required angle of convergence, in spite of the excess of accommodation, and there is no squint. In very high degrees also, there is usually no squint, for the strongest accommodative effort proves insufficient to bring the eye into focus, and is therefore instinctively abandoned. It is thus, in moderate degrees, that strabismus is most likely to arise. It commonly begins in childhood at the time when the eyes are first freely used on near objects; as in learning to read and write. At first the strabismus is often periodic, appearing and disappearing in accordance with the amount of accommodative effort made. After some weeks or months, it generally becomes confirmed in distant as well as in near vision. When the two eyes have equal degrees of hypermetropia and are equally sharp-sighted, the squint is likely to alternate between them according to the position of the object looked at; thus, in looking at an object to the right of the middle line the left eye will be used, while the right deviates inwards, and *vice versa*. But, if either eye be at a disadvantage as regards the degree of the hypermetropia, the presence of astigmatism, opacity of the cornea, or any other defect, the patient will instinctively at all times fix with the better eye and squint with the worse. In a few cases, a squint remains periodic for many years, and in a few it continues for a long while to alternate, but in the large majority it becomes persistent and constant in the one eye.

Referring again to the simultaneous action of the convergent and the conjugate centres necessary to bring the one eye to bear upon the object, it will be seen that in the fixing eye the two impulses fall one on the internal, the other on the external rectus, while in the squinting eye both fall on the internal rectus. The persistent contraction of the latter leads to its permanent shortening, so that, even in the absence of all accommodative effort, parallelism of the eyes is not recovered. In the squinting eye, the picture is formed at some distance from the macula lutea—that is, at a less sensitive part of the retina than in the fixing eye—hence it is easily neglected or suppressed, and the eye becomes amblyopic from non-use. In many cases of long standing, the squinting eye loses all power of true fixation, and, even when the good eye is covered, is wrongly directed in its efforts

to look at the object. Double vision is uncommon in this form of strabismus; the absence of a faulty projection may be connected with the fact that the position of the deviating eye is not independent of and disproportionate to the impulse of the will, but is the normal result of an excessive impulse. See OCULAR MUSCLES, Affections of the.

There are a good many cases of comitant strabismus in which, though hypermetropia is probably the essential cause, the circumstances of the onset, the apparently capricious appearances and disappearances, and the variations in the amount of the deviation, demand some further explanation. Thus, a squint not infrequently begins during an attack of hooping-cough, measles, or some other childish disorder, or after a fright; it is distinctly aggravated by digestive or mental disturbance; it may even vary regularly from day to day, or at longer intervals, with remarkable periodicity. In such cases; it may be assumed that the convergent centre, always irritable and tending towards overaction by reason of the hypermetropia, is suddenly thrown into a state of spasm by other causes, or possibly that the controlling action of the opposing centre is weakened or lost. There are, moreover, cases of convergent strabismus in all respects resembling those now under consideration, except that there is no hypermetropia; these, however, form a very small minority.

Symptoms.—These have for the most part been described in the foregoing paragraph. The first step in making the clinical examination is to make sure that the squint is real and not simply apparent. In young children, the appearance of a convergent strabismus is sometimes simulated by the condition termed epicanthus, a redundant fold of skin between the eye and the nose, which overhangs the inner canthus and makes it appear that the cornea is too near to it. The appearance is at once removed by pinching up the skin at the root of the nose between the finger and thumb. Again, in nearly all eyes the axis of the cornea forms an angle with the axis of vision, or, in other words, the point at which the eye actually looks lies not exactly in a line with the anatomical axis of the globe, but a little to its inner side. In the normal eye the angle amounts to about 5° ; if it be much less than this, as it often is in myopia, we have an apparent convergent strabismus, while if it be greater, as in some hypermetropic eyes, a divergent strabismus is simulated.

The presence of an actual deviation is easily proved. The patient being told to look at a distant object, we hold a hand or a card over each eye in turn; if either eye moves when the other is covered, in order to look full at the object, we know that it was previously directed wrongly; we thus learn which eye habitually fixes and which deviates. If no deviation manifests itself while both eyes are open, we note whether either eye deviates behind the hand covering it; and supposing no deviation to be discoverable, under any circumstances, in distant vision, we ascertain whether a squint is elicited by accommodation for a near point, as in reading small type held in the hand. A squint, which occurs only when the eye is excluded from participation in vision, is termed *latent*, while one which persists when both eyes are uncovered, is termed *manifest*. Each eye is then tested with regard to its ability to move freely inwards and outwards, in order to ascertain whether there is any decided limitation of movement, either through shortening of the one muscle or weakening of its antagonist.

It is well also to measure the amount of the deviation, although this is not essential for correct treatment. It may be done either by linear or by angular measurement. The good eye being fixed on a distant object straight in front of the face, the distance between the centre of its cornea and the inner canthus is measured on the lower lid by means of a small scale or strabismometer, and then, before any movement is made, a similar measurement is made in the squinting eye; the difference between the two measurements represents the amount of the deviation. A more precise, though rather more troublesome, method is to make an angular measurement with the perimeter. A distant object is placed in line with the axis of the instrument, and the arc is placed horizontally; the deviating eye is then placed in the usual way at the centre of the arc, and the patient is told to look at the distant object; this he does with the good eye. Taking a lighted candle in his hand, the observer passes it along the arc, keeping his own eye close to it, until the reflection of the flame appears in the centre of the cornea of the deviating eye; the position of the candle is then read off upon the arc. The angular distance between this point and the centre of the arc represents the angular deviation of the eye. More important than a precise measurement of the deviation is the estimation of the refraction in both eyes. With the help

of the shadow test (retinoscopy) this is very easily and quickly done, even in young children, and even though the squinting eye be highly amblyopic. If the patient is old enough, the acuity of vision should also be ascertained. The prospect of obtaining a complete cure varies in proportion as the acuity of the deviating eye is good or bad.

Treatment.—A periodic strabismus may usually be removed entirely, for the time being, by the free use of atropine to both eyes, for, so soon as the ciliary muscles are completely paralysed, accommodative efforts are abandoned, and the excessive convergence dependent on these efforts disappears; if any shortening of the internal rectus has already taken place, the atropine will not remove the deviation, though it will probably diminish it. The use of eserine may produce the same result in exactly the opposite way. By a moderate use of eserine, it is possible to increase the excitability of the ciliary muscles without keeping them in a state of spasm; so that to a given impulse they will respond more vigorously than in the normal state. With its help the hypermetrope may thus succeed in accommodating sufficiently without excessive effort, and, consequently, without excessive convergence. These remedies are, however, temporary in their effects. By some surgeons atropine is employed as a preliminary to other measures, in all cases. Eserine is less frequently used. The essential treatment of a convergent strabismus consists in the correction of the hypermetropia by glasses, and if this does not remove it, in tenotomy of one or both of the internal recti. Glasses should be given which correct the greater part of the hypermetropia discoverable by retinoscopy, which will usually be greater than the amount which is manifest on testing with types and lenses. These should be worn constantly. If the deviating eye be amblyopic from non-use, it should be used alone, while the other is covered, for a few minutes every day; by this means its acuity will probably be raised, and the prospect of restoring binocular vision greatly improved. At the end of from one to three months, the benefit obtainable by optical means will usually be manifest, and, if the strabismus persist, the case must be treated by tenotomy. Children should not, as a rule, be operated on until they are old enough to wear glasses—i.e. until about six years of age. If a strabismus appear much earlier than this, it may be combated for a while with atropine, and the acuity of the squinting eye may be kept intact by covering the other

with a shade or a bandage for a certain time each day.

Tenotomy of the Internal Rectus.

The tendon of the internal rectus is attached to the sclera at about 5 mm. from the corneal margin, and more loosely by connective tissue to the conjunctiva and to Tenon's capsule—the fibrous envelope which surrounds the globe and separates it from the other contents of the orbit. The operation of tenotomy consists in completely dividing the tendon close to the sclera, and separating it more or less from its other attachments; these latter prevent it from withdrawing itself completely from the globe, and retain it in a more or less retracted position, where it forms a fresh and firm adhesion with the sclera. The aim of the operation is to set back the insertion of the tendon sufficiently to neutralise the effect of its previous shortening, without abolishing its ability to rotate the eye inwards to the normal extent. When the deviation exceeds 5 mm. in extent—that is to say, in the majority of cases which come under notice—it is better to operate on both eyes, setting back the tendon to a moderate distance in each, than to attempt to obtain the whole correction in the one; symmetry of the attachments in the two eyes is thus retained, and the danger of displacing the one tendon to such an extent as to impair its efficiency is avoided. The connective-tissue attachments of the tendon should, however, be divided more freely in the eye which habitually squints than in its fellow, so that the effect may be greater on this side than on the other. An over-effect is guarded against most certainly by operating on one eye only at one time; but, in very many cases, an experienced operator may with confidence divide both inner recti at one time, especially if he adopt the subconjunctival method recommended below.

An anæsthetic—chloroform or ether—has, until lately, always been found necessary in children; in older subjects, with ordinary self-control, it may be dispensed with. Since the introduction of cocaine as a local anæsthetic, the practice in this, as in many other ophthalmic operations, is changed. Two or three applications of a two or a four per cent. solution, at intervals of two or three minutes, produce insensibility in the conjunctiva, and a few minims of the solution may then be injected beneath the conjunctiva, by means of a hypodermic syringe without causing pain. The whole of the operation is thus rendered almost, if not absolutely, painless. A

special advantage of this method is that the amount of effect produced by the tenotomy in the one eye can be better estimated at once, before the other eye is dealt with, than when the patient is under the influence of a general anæsthetic. The instruments required are the speculum, the fixing-forceps, a strabismus hook, one which is flattened sideways and not bulbous at the extremity being in the writer's opinion the most convenient, and a pair of blunt-pointed straight scissors; curved scissors are used by some operators, but have no evident advantage, and in unpractised hands are likely to be passed too far backwards along the surface of the sclera, a mistake which is followed by copious bleeding into the orbit and protrusion of the globe; a needle threaded with silk or gut is sometimes required as well.

The patient is placed in the recumbent position; the surgeon stands at the patient's right hand, in which position he is conveniently placed for operating on both eyes. He separates the lids widely with the speculum; with the fixing-forceps, held in the left hand, he seizes the conjunctiva below the insertion of the internal rectus—i.e. about midway between the canthus and the corneal margin, but an eighth of an inch or more below the horizontal meridian of the globe. With the scissors, in the right hand, he snips through the conjunctiva, and then, if it be not divided at the same time, picks up the subconjunctival fascia and divides that in like manner, the aperture being large enough easily to admit the scissors with closed blades, but not larger. The blades may then be introduced into the wound, and widely opened beneath the conjunctiva so as to stretch without cutting its connections with the outer surface of the tendon; or, if a considerable correction has to be effected, these attachments may be divided by a few snips towards the canthus, care being taken to keep the points well forwards beneath the conjunctiva, and not to cut deeply backwards along the curvature of the globe.

The scissors are then laid down, and while the forceps in the left hand still hold the conjunctiva close to the wound, the hook is taken in the right hand, and with its concavity turned away from the operator, and its point directed backwards as though it were to be carried towards the posterior pole of the eye, is passed deeply into the wound and swept round along the surface of the globe, so that its point passes upwards between the tendon and the sclera, and projects beneath the conjunctiva above

the insertion of the tendon. If an attempt be now made to carry the hook forwards towards the cornea, it will be found to move the globe by its traction on the tendon beneath which it lies. The forceps are now laid aside and the hook is transferred to the left hand, and held parallel with the side of the nose and with some forward and outward traction upon the tendon; the scissors, held in the right hand, are passed with slightly opened blades between the hook and the eye, so that one blade passes on each side of the tendon, and then with one or two snips, the latter, which is felt as a firm resisting substance, is cut through as close to the sclera as possible. When the tendon is completely divided, the hook can be brought forward beneath the conjunctiva quite up to the margin of the cornea; it should be re-introduced in the same manner as before to make sure that the division is complete. If much blood be effused beneath the conjunctiva, a small aperture may be made with the scissors above the insertion of the tendon to favour its escape. The bleeding is likely to be more profuse when the subconjunctival fascia is freely divided with the scissors, than when it is simply stretched by widely opening the blades beneath the conjunctiva.

The after-treatment consists merely in keeping a fold of wet lint over the closed eyelids for a few hours, and avoiding exposure to wind, bright light, and other possible sources of irritation during the next few days. A little finely powdered iodoform, dusted upon the conjunctiva in the neighbourhood of the wound, is a good safeguard against septic inflammation of the tissues, a complication which is occasionally met with in badly nourished subjects, and which, in very rare instances, has been known to lead to orbital cellulitis and loss of the eye. The discoloration due to the extravasated blood, which may extend to the eyelids, usually disappears in from two to five weeks.

Disasters during the operation are seldom met with; if sharp-pointed scissors be used, or if the blades be introduced with much force, it is possible, however, to wound the tunics of the eye. If the globe is pushed forwards by a deep outpouring of blood into the orbit before the tendon is divided, cold compresses and a roller bandage should at once be applied, and the tenotomy postponed. If the immediate effect of the operation is manifestly insufficient, it may be increased by a further division of the subconjunctival tissue or by passing a silk suture underneath the conjunctiva, near to the external margin of the

cornea, so as to include about 6 mm. of it, and fastening the two ends to the skin of the temple with strapping, so as to draw the eye into a position of strong outward deviation; or the suture may be introduced close to the external margin of the cornea, and carried underneath the conjunctiva to the external canthus, and then tied over, so as to gather the conjunctiva into a fold which draws the eye outwards. The suture should remain for a day or two. Should the immediate effect be obviously too great, it may be diminished by a similar conjunctival suture at the inner side of the eye, or later, if it should prove necessary, by division of the external recti or advancement of the inner, one or both, or by a combination of these measures. The immediate effect should be that the eye cannot be turned so far inwards as before, the tendon now acting only through its connective-tissue attachments; during the following week the effect diminishes as the tendon forms a fresh and firm adhesion with the sclera; ultimately it again somewhat increases as the uniting tissue becomes stretched by use.

A simple subconjunctival tenotomy, with little cutting of the subconjunctival fascia, usually alters the position of the eye to the extent of 3 or 4 mm. If it is found, at the close of the operation, that the patient can converge for a point about six inches from his face, and can maintain this degree of convergence steadily, a perfect result is likely to be obtained; but if either eye deviates under this test, the effect of the tenotomy is likely to prove somewhat too great or too small, as the case may be. The continued use of spectacles after the operation is generally desirable, both as a safeguard against a return of the strabismus, and for the sake of good vision; if, however, the effect of the tenotomy tends to be too great, it is sometimes well to leave a part or the whole of the hypermetropia uncorrected, so as to call more or less of the extra accommodation into play, and thereby to increase the convergent effort. Several slightly different methods of performing tenotomy for strabismus are in use. The chief variation from the method described above consists in making the aperture directly over the insertion of the tendon instead of below it. By this proceeding the tendon is exposed to view as it lies upon the hook, and the principle of dividing it subconjunctivally is abandoned.

Tenotomy of the External Rectus is sometimes required to neutralise the effect

of an excessive operation on its antagonist; it may conveniently be referred to here, although it does not usually form part of the treatment of convergent strabismus. The steps of the operation are essentially the same as those of the operation just described, but, it is to be noted that the insertion of the tendon is about 2 mm. further from the margin of the cornea than that of the internal rectus.

Advancement or Readjustment of the Internal Rectus is practised for the removal of the divergence which occasionally results from a too free division of the muscle in the treatment of convergent strabismus, and for divergence due to paralysis and other causes. It is a less simple and more painful operation than that of tenotomy. It consists in dividing the tendon at its point of attachment to the globe, and drawing it forward and detaching it in an advanced position, by means of sutures passing through it and the conjunctiva, until it forms a fresh attachment. The advancement of a tendon is usually combined with division of its antagonist, but this latter step is not always required, and may, sometimes, with advantage be postponed until the permanent result of the advancement can be estimated. The operation is performed in several slightly different ways. The following gives good results and is perhaps the simplest. In addition to the instruments used in an ordinary tenotomy, a silk or fine gut suture threaded into three curved needles is required; one needle is drawn along to the middle point of the thread, the others are placed at each end.

A vertical incision is made through the conjunctiva corresponding with the insertion of the tendon to be advanced, but not more than an eighth of an inch from the corneal margin. Its lip, together with the subconjunctival fascia, is dissected back a little way towards the canthus so as to expose the insertion of the tendon, but a separation of the conjunctiva from the tendon is, as far as possible, avoided. The tendon is divided on the hook in the usual way. One blade of the forceps is passed into the wound, and the divided tendon is firmly seized, together with the conjunctiva and fascia lying over it. The middle needle is then passed through these structures from within outwards, so as to pass as nearly as possible through the middle of the tendon behind the forceps, and the other two needles are, in like manner, passed beneath the conjunctiva in the opposite direction and brought out near to

the corneal margin above and below, at or even beyond the middle line. The middle needle being cut off, the two sutures thus formed are tied above and below, so as to draw the tendon forwards towards the corneal margin, and throw the included conjunctiva into folds. The further back in the tendon the sutures lie, the greater is the effect which can be attained. The immediate effect should be considerably greater than the permanent effect desired. Some pain is complained of during the first twelve hours, and there is sometimes a good deal of swelling of the lids, the patient should therefore be kept in bed a day or two, with cold compresses over the closed eyelids; and, as a safeguard against suppuration, a little finely powdered iodoform should be dusted on the conjunctiva twice daily. The sutures may be removed on the third or fourth day, or, if gut is used, may be left much longer without danger of their causing irritation.

DIVERGENT STRABISMUS (MYOPIC).—In a large proportion of cases myopia underlies this condition, just as hypermetropia underlies the convergent form, and to a certain extent the one condition is pathologically the counterpart of the other. In looking at an object at any given distance, the myope needs to make a smaller accommodative effort than the normal-sighted person, and, if the object be at or beyond his farthest point of distinct vision, he sees best by avoiding accommodative effort altogether; but since accommodation is closely associated with convergence, he will at the same time be apt to make an insufficient effort of convergence—that is to say, one eye will be likely to deviate outwards, while the other is directed to the desired point. A *latent insufficiency of convergence*—that is, an insufficiency appearing only when one eye is covered—is common in all degrees of myopia, while a *manifest divergent strabismus* is met with chiefly in association with the higher degrees. The former may be accounted for almost entirely by the abnormal relations between accommodation and convergence; the latter is traceable to another cause as well. The elongated form of the highly myopic eye offers an obstacle to its rotation in any direction, while the very fact of the myopia obliges the patient to bring objects very near to his eyes, and, if he is to enjoy binocular vision, to maintain an excessive degree of convergence. The double difficulty is insurmountable. Binocular vision is abandoned in looking at very near objects, and,

as a recompense for its loss, the patient is freed from the necessity of any convergent effort and from any associated accommodative action, which would of course only increase his difficulties. Any other imperfections of the eyes, which add to the difficulties of binocular vision or render it of little value, such as difference in the refraction of the two eyes, astigmatism, corneal opacities, or retinal changes, promote the deviation of the less useful eye. When once such a deviation in near vision has begun, it is likely to pass into a divergent strabismus for all distances.

Although myopia is, for the reasons stated, the commonest cause of this form of strabismus, any condition which renders the combined action of accommodation and convergence unnecessary, may lead to it; thus, an eye which from any cause has been long out of use, is liable to assume a position of outward deviation, especially if by reason of myopia, defective sight, or loss of accommodative power in the other eye, no habitual accommodative efforts are made. The slighter forms of latent divergent strabismus are frequently described under the name *insufficiency of the internal recti*; but there is no reason to suppose that the muscles are essentially defective in these cases, any more than in other forms of concomitant strabismus, and, indeed, these same muscles show no deficiency of power in conjugate movements; it is the impulse which is insufficient, either absolutely or relatively to the resistance to be overcome. Such insufficiency is induced artificially, when the accommodative effort habitually required for a given distance is diminished by optical means; thus, if a normal-sighted person attempt to read with convex glasses, he will find difficulty in maintaining the necessary degree of convergence, and if a myope, who habitually reads with concave glasses, tries to read without them, he will do the same.

In certain cases of high myopia, while there is an inability to converge sufficiently for very near objects, the eyes remain too convergent in distant vision, the abnormal form of the eye limiting its excursions in all directions.

The *diagnosis* of divergent strabismus is usually made with certainty by the tests already described; in the slighter latent forms it is made with greater precision by means of a prism. Both eyes being fixed upon an object, such as a flame in testing distant vision, or a vertical line on a sheet of paper in testing near vision, a prism of 8° or

10° is held base downwards before one eye. The image belonging to this eye appears to the patient to be displaced upwards, and fusion of the two under these circumstances is impossible. The eyes at once assume the particular degree of divergence or convergence which is most easy in connection with the given effort of accommodation; if the convergence be normal for the distance in question, the eye will remain stationary, and the two images will remain vertically placed the one above the other; if it be insufficient, the eye will move outwards and its corresponding image, the upper one, will appear to move in the opposite direction. The slightest deviation of the eye is thus revealed by the deviation of the image; it must be noted, however, that slight deviations obtained in this manner are often devoid of all practical importance. Subjectively, a latent divergent strabismus may cause much difficulty and pain in reading or other use of the eyes on near objects.

Treatment.—The insufficiency of convergent effort in near vision, which often accompanies the slighter degrees of myopia, may be remedied by giving concave glasses which correct a part or even the whole of the myopia, and thus induce a normal accommodative effort; in higher degrees, it may be neutralised by decentring the glasses—i.e. by setting them so that their centres are farther apart than the centres of the pupils, and thus giving them a prismatic effect, or by prescribing prisms for near work. See Myopia, under REFRACTION, Errors of. But it is to be remembered that, in high degrees of myopia, a divergent strabismus in near vision is to some extent a preservative change, tending, by abolition of the convergent strain, to save the eye from increase of structural mischief. The operative treatment of divergent strabismus consists in diminishing the effect of the external rectus by tenotomy, and sometimes by advancing the internal rectus in the manner already described. An operation cannot safely be undertaken unless the eyes are actually divergent, or unless they are found to be able to diverge to an extent sufficient to neutralise the effect of a prism of at least 10° held, base inwards, before one eye.

PRIESTLEY SMITH.

STRANGURY.—A frequent, almost constant, and irrepressible desire to void urine, which is expelled in drops by acutely painful, spasmodic contraction of the bladder and perineal muscles.

Strangury is a symptom, not a disease, and may be called forth by irritating or inflammatory affections of any part of the urinary tract. In the kidney, frequent causes of strangury are nephritis and intense renal congestion, such as follows in some persons the absorption of turpentine or of essential oils allied to turpentine, or of cantharides. Another cause is some morbid condition of the calyces of the kidney, such as the presence of calculus, tubercle, or cancer. In the ureter, the passage of a calculus from the kidney to the bladder will excite severe strangury. Of the bladder, cystitis, stone, or tumour are very constant exciters of strangury. Of the prostate, acute congestion, especially in old men, when there is hypertrophy, is a very frequent source of strangury. The affections of the urethra which are apt to cause strangury are urethritis, especially gouty inflammation of the deeper portion, or gonorrhoeal inflammation of the mucous membrane of the neck of the bladder, stricture, or lastly, preternatural narrowness of the meatus urinarius.

The course and terminations of strangury are those of the disease which excites it in great measure; but it is essentially a spasmodic affection, and therefore has intervals of quiet between the acutely painful attacks. Aggravation in severity of attacks of strangury is greatly promoted by locomotion, by exposure of the surface of the body to cold, by food generally, and especially by stimulants of all kinds.

The *treatment* of strangury consists in the removal of the cause, the cure of the disease exciting the irritation, or, if that be impossible, the soothing of its effects. To those persons who suffer strangury from cantharides, other vesicants should be applied, and turpentine, copaiba, or sandalwood oil be withheld from those in whom those drugs produce renal congestion. When the cause depends on inflammation of the kidney or bladder or urethra, rest in bed, warm hip-baths, leeches, and hot fomentations are useful. Internally, free saline purging and the administration of belladonna, combined with opium or not, are the main resources. It is customary to direct bland liquids such as barley water, effervescing waters, milk, &c., to be taken freely during the attack. The writer believes that thirst may be slaked by small quantities of iced drinks; the spasm is more quickly allayed when the secretion of urine is not encouraged by the imbibition of large quantities of watery fluid.

BERKELEY HILL.

STRIÆ ET MACULÆ ATROPHICÆ.

Definition.—White scar-like streaks and spots on the skin, slightly depressed below the surface.

Etiology.—Both striæ and maculæ are seen in both sexes at all ages, and may be idiopathic or symptomatic. The idiopathic striæ are most frequent in adults, and much more frequent among women who have never had children than among men, and they are more frequent in tall than short men. They are supposed, in these cases, to be due to stretching of the skin during the expansion of the pelvis and growth of the limbs. Symptomatic striæ, more generally known as lineæ albicantes, are seen most frequently after pregnancy, and are due to stretching of the subcutaneous tissue by distension; they occur from any cause of similar distension, such as ascites, ovarian or other tumours, and even accumulation of fat if rapidly developed, and in the breasts from lactation. No satisfactory explanation of idiopathic maculæ can be offered, but a similar kind of lesion, though usually classed as scars, occurs from external pressure such as results from corns, favus crusts, &c.; and the depressions remaining after absorption of inflammatory or other infiltrations of the corium, such as result from syphilis, lupus, leprosy, lichen ruber, planus, &c., are of a similar nature.

Symptoms.—The idiopathic form occurs as streaks or spots; the streaks are from one to several inches long, and a quarter of an inch or more wide, lying in parallel lines at various angles to the long axis of the body, and are situated chiefly about the buttocks, the anterior border of the ilium, the trochanters and thighs, rarely on the trunk, neck, and arms. They are pearly or bluish-white, scar-like, irregular lines, slightly depressed below the surface of the skin, which is evidently thinned in the shallow sulci. The lineæ albicantes of pregnancy, &c., before alluded to, present ultimately the same physical characters as the so-called idiopathic striæ, but at first are bluish-red from hæmorrhage, and very itchy. Striæ tend to become less conspicuous ultimately, from their edges being drawn together by the natural elasticity of the skin, but they never go away entirely.

Maculæ or spots are less common than striæ; they vary from a large pin's head to half a crown in size, are white, slightly depressed, and are seen mostly on the trunk and neck; and there is reason to believe that they are only the sequel to a more acute condition. Liveing observed a case where the spots were in all stages: in the

first, the spots were slightly red, raised above the surface, hard and fibrous; the characteristically white, sunken spots soon followed on the site of the raised spots; and finally the skin contracted, and the healthy tissues were drawn together and the spots nearly obliterated. Other observers mention antecedent hyperæmia as occurring in some cases, and, as they give rise to no inconvenience, probably the early stage is usually overlooked.

H. RADCLIFFE CROCKER.

STRICTURE OF THE URETHRA:

loss of the natural distensibility of this canal over a limited area, whereby the passage is narrowed at that part.

When at rest, the walls of the urethra are drawn closely together by its elastic and muscular contractility. They so remain until separated by a stream of urine or by a sound; further, as the flow of urine or sound pass outwards, the walls close again immediately behind them. This statement, though true for the greater part of the canal, is not quite so for the prostatico-membranous portion; the complete evacuation of this part is achieved by certain muscles which are under voluntary control. The elastic tension of the urethra will yield readily before a sound of greater size than that to which the passage is ever expanded by the flow of urine, and the width of the urethra consequently depends, within certain limits, on the amount of distending force applied. Hence, the ordinary size of the urethra means the width to which the closed tube must be dilated, to give the urine an unimpeded escape when driven from the bladder. During the flow of urine, the contractile and elastic fibres maintain a tonic pressure on the stream, to ensure its forcible ejection from the body.

The natural expansibility of the urethra differs in different parts of its length; in the prostatic and membranous portions it is greatest, having there a diameter of at least 18–20 millimètres (about three-quarters of an inch), sometimes more; and thus it allows of the passage of a man's forefinger as far as the neck of the bladder. It may be mentioned that in speaking of the sizes of urethral instruments, the French scale, where the numbers advance by 1 millimètre added to the circumference, is always followed by the writer. As the urethra passes through the triangular ligament, it is often narrower than elsewhere, except at the meatus urinarius. At the bulbous portion it widens again considerably for about two inches of its

length, and then contracts slightly during the last three inches to the meatus, which is commonly the narrowest point of all. As the penis varies in circumference in different persons, so does the urethra in dilatability; the extremes of the latter being between about 20 millimètres and about 40 millimètres; the usual expansibility being 30 or 32 millimètres. At the meatus the expansibility varies very greatly, from a mere pinhole to 40 millimètres; the most common size being 25 millimètres, or almost exactly one inch. Otis, of New York, maintains that there is a constant relation between the circumference of the penis behind the glans and the dilatability of the urethra. Thus, an outside circumference of three inches is accompanied by a urethra of a capacity of 30 millimètres; one of three and a half inches by a urethral capacity of 34 millimètres, and so on. The writer has found this a usual condition but not an invariable one, and, consequently, places little reliance on the outside measurement when desiring to know the interior capacity.

To ascertain the expansibility of the urethra or the existence and position of unyielding parts, the following instruments are necessary:—A set of bullet-sounds, some with narrow stiff stems, some with flexible ones, carrying bullets shaped like a turkey's egg, varying in circumference at the widest part from 8 to 40 millimètres. Besides these, an Otis's urethrometer is useful, which can be enlarged from 12 millimètres (about No. 6 of the English catheter scale) to 44 millimètres. The meter is useful to measure the urethra in cases of narrow meatus, or where a thin bridle of membrane, near to the meatus, prevents the condition of the urethra behind such a constriction from being explored by a sound of greater width than that of the contracted point. But it cannot be readily introduced beyond the triangular ligament, and therefore is most useful as a gauge of the penile portion of the canal. The bullet-bougies with wire stems can be bent to suitable curves, and with a little management passed to the bladder without giving pain.

The *causes* of stricture are several, but of them, two are by far more frequent than the rest. (1) The great majority of strictures are the consequences of long-continued inflammation, with or without shallow ulceration of the mucous membrane, set up by gonorrhœa; hence gleet should never be neglected, as they are frequently the only indication of the existence of a patch of inflammation in some part of the urethra,

which is slowly changing the mucous membrane there into undilatable fibrous tissue. (2) The next most frequent cause is laceration of the urethra by kicks or blows, which heal by a contracting scar. These are most commonly situated in the perineum, but may be produced at any part of the urethra. (3) Intra-urethral chancre, always near the meatus, caustic applications, lacerations caused by a calculus or by the disintegration of tubercle, are also causes, but rare ones, of stricture by the scars they leave behind them.

Age.—Stricture may be met with at any age. When before puberty, it may be caused by the injury done by an impacted calculus, or by the development of a scar after the healing of tubercle in the urethra. A case of tubercular stricture came under the writer's notice a few years ago; in which instance the cause of the stricture was ascertained *post mortem*. But as gonorrhœa is the greatly preponderating cause of stricture, and as the most common age for that disease is eighteen to twenty years, and as, moreover, stricture generally needs three years or more for its development, the decade in which strictures usually become troublesome is between thirty and forty.

The abnormal narrowings of the urethra are classified as—(1) *inflammatory*, (2) *spasmodic*, (3) *organic*. The organic stricture is the only contraction to which the term 'stricture' is applied by some surgeons; but as the other conditions not infrequently cause impediment to the flow of urine, and a narrowing of the urethra which is very easily measured, they may also be fairly termed strictures though the contraction be only transient.

INFLAMMATORY STRICTURE is a temporary local congestion and swelling of a part of the urethra, which is generally, not always, the site of some permanent induration; in other words, a stricture of wide calibre contracted by temporary swelling.

It is usually sudden in its onset, and of short duration if appropriately treated. It is met with in persons of gouty habit of body, who indulge freely in the pleasures of the table or in venery, or who, having some permanent stricture, after exposure to damp and chill get congestion of the urethra at the strictured part. The small inconvenience of this permanent stricture is suddenly and seriously aggravated into more or less complete closure of the urethra for purposes of micturition. The leading symptom is inability to pass, or great difficulty in making, urine. To this are added dull pain in the perineum, some fever, considerable anxiety

and distress, slight redness and swelling of the meatus urinarius, with thin purulent discharge. The affection is distinguished from prostatic congestion by the absence of tenderness and swelling of that organ.

The immediate treatment consists in relieving the retention with a soft, flexible catheter, No. 8 or 14 French (4 to 7 English scale), soothing the irritation by a smart purge, followed by rest in bed and salines, with opium and belladonna in small frequent doses. In one or two days the trouble ceases, and a régime must then be adapted to exclude the causes which brought on the attack. Any small organic stricture must be widened when the inflammation has subsided. This affection is very apt to recur again and again, whenever the causes already mentioned come into operation.

SPASMODIC STRICTURE is a narrowing of the calibre of the urethra by contraction of the muscular fibres of the canal. It is always met with in the deeper portion, where the muscular bands are most numerous. It may accompany the inflammatory swelling just described. In such cases, of course, the amount of the contraction due to swelling and of that due to spasm cannot be apportioned accurately to the two causes. But spasmodic stricture is also met with without inflammation—e.g. when reflex irritation is set up in the perineal muscles by the presence of a fibrous stricture at or near the meatus. Such a contraction is easily detected by the bullet-sound behind the bulbous portion, and often causes difficulty and even pain in micturition. If the anterior fibrous stricture be enlarged, the contraction and impediment in the deeper portion at once disappear. Such a condition is often mistaken for organic stricture near the bulbous portion, if by imperfect examination of the urethra the surgeon has overlooked a small amount of stricture near the meatus, and discovers only the spasmodic contraction behind the bulb, which may let pass only No. 12 or 13 (No. 6 of the English scale). Of course such spasmodic strictures disappear at once under anæsthetics.

Spasm is very apt to increase the contraction of an irritated or inflamed organic stricture, and is readily assuaged by the remedies which have been prescribed for the treatment of inflammatory stricture, especially by sufficient widening of organic contraction, if that be present.

ORGANIC STRICTURE is due to the formation of a new product of a slowly contracting nature. This permanent contraction is often increased, as already said, by

temporary inflammatory swelling and muscular spasm.

The new material is produced in various ways. Its earliest stage is inflammatory congestion of limited areas of the mucous and submucous tissue, from which the new growth may extend deeply into the erectile spongy tissue beyond those limits. It may, on the contrary, be limited to a few short bands stretched across the urethra or surrounding it. These narrow bands are termed *bridle strictures*. They are found in the ante-scrotal portion. Besides almost exclusively originating in inflammatory patches without ulceration, the spreading fibrous tissue may begin at the roots of warts, or in the floor of healing ulcers of the mucous membrane.

The indurated areas may take the form of hard knots or projections of the mucous membrane, which divert the canal with sudden twists; or, instead of forming circumscribed masses, the induration sometimes surrounds the canal, converting it for some distance into an unyielding tube of uneven surface. Hence, the stricture may vary from a thread-like band to a gristly mass invading the whole corpus spongiosum except the glans, where it never completely replaces the erectile tissue, and it may pass beyond the perineum, rendering the whole of that region hard and leathery.

The organic stricture also varies in the position of the new product and in behaviour. First, the *localities* of strictures. Strictures are found in any part of the canal as far back as the triangular ligament; and, by slow extension backwards, the fibrous induration may spread to the membranous portion, and even to the neighbouring part of the perineum. Taking all forms of fibrous stricture together, contraction is most frequent near the meatus, in the last half-inch of the urethra. Beyond the last inch, passing towards the bladder, strictures are less and less frequently met with, until the bulbous part is reached, when they again become frequent, though less so than at the outlet of the passage. In the bulbous portion, the narrowest, thickest, and toughest strictures are more commonly found, on account of the depth to which the new formation penetrates into the erectile tissue, and the mass of it which is thus produced at this situation. But very tight and massive strictures may be developed near the meatus, without any contraction existing at the bulb.

Strictures seldom extend far into the membranous part, and probably never begin there. The prostatic portion is involved

only where very extensive injury has reached the perineum. Such cases the writer has met with in miners, whose pelves have been crushed by falls of earth or the like accidents. The pubic portion of the pelvic bones has been broken and the urethra beneath them destroyed, so that, when the wounds have healed, the perineum is transformed into a mass of cicatricial tissue, through which the urine reaches the surface by one or more fistulæ.

Strictures are more often multiple than single. There are usually two or more contractions near the meatus, with an additional one in the bulbous portion. But a solitary stricture may exist at any part of the canal.

Produced in these several forms, it may be readily understood that the *behaviour* of strictures varies greatly. Some are rigid and cannot be dilated nearly to the natural expansibility of the urethra. After giving way in some degree to the introduction of the expanding bougie, the urethra yields no more. Further attempts to pass larger instruments excite inflammatory complications in the urethra itself or in the kidney, bladder, or testicle, with more or less constitutional disturbance attending them. Other strictures yield easily to dilatation and slowly contract; such have usually scanty development and a recent origin. A third set of strictures yield easily before the dilating force, but quickly shrink back to their former narrowness (india-rubber strictures).

Besides the changes in the urethra at the situation of the strictures, others take place in consequence of the irritation or injury to, which the canal is subjected by the straining efforts of the bladder and perineal muscles to expel the urine, or by the treatment employed to relieve the difficult micturition. Between the meatus and the narrowest stricture, the passage, sometimes quite healthy, is more often marked with excoriations and ulcers. Just in front of the main stricture, there are sometimes perforations of the urethra into the cellular tissue, occasionally passing into the urethra again behind the stricture or into the rectum. These are termed 'false passages.' At the stricture itself, the surface is dull and roughened, and the canal somewhat tortuous; behind it, the walls are dilated, pouched, and the pouches lined with ragged ulcerated tissue. Through such pouches also fistulæ and urinary extravasations break away, from the strain to which their weakened walls are put by the impediment in front.

In cases of long continuance, the bladder is affected with chronic catarrh. If examined *post mortem*, its mucous membrane is rigid, thickened, and of an ashy-grey colour; here and there are often patches of crimson or purple colour from irritation excited shortly before death. The capacity of the bladder is generally diminished, though in old men it is sometimes dilated. The muscular coat is thickened so as to cause marked fasciculation of the inner surface. Between these ridges, pouches or sacculi are common.

The changes in the kidneys are those of chronic over-distension, either with or without acute inflammation. The ureters and the pelves of the kidneys are widened through the obstruction of the orifices of the ureters by the swelling of the mucous membrane of the bladder and the hypertrophy of its muscular fibres, and are also tortuous or pouched. Their interiors, like that of the bladder when attacked by inflammation shortly before death, are marked by red patches, but generally the surface is dense, white in colour, here and there ulcerated; the ulcers being often covered by a sheath of thick mucus. The urine in these diseased ureters and pelves is ammoniacal and horribly fetid. The changes in the kidney consist in those caused by simple pressure of the urine dammed up in the bladder, ureters, and pelves. The organ is softened, greatly enlarged, the calyces dilated, the pyramids flattened, and the cortical substance spread in a thinner layer than in the healthy organ; the capsule is toughened. The interior may be so far expanded, in extreme cases, as to convert the pyramids into funnel-shaped pouches, the cortical substance being almost wholly atrophied. In addition to this simple expansion, the kidney is commonly altered by repeated attacks of interstitial inflammation, with or without the formation of circumscribed abscesses. See PYELONEPHRITIS.

The *symptoms* of organic stricture depend much on the degree to which the disease has developed. Those which usually first attract the patient's attention, are caused by considerable diminution of the calibre of the urethra.

In the early stages, when the disorder is easily managed and probably capable of complete cure, the symptoms are obscure. The most constant symptom is a scanty, muco-purulent discharge, not exceeding a small drop of whitish fluid collected at the meatus on rising from bed in the morning; or even not more than a few shreds of inspissated mucus floating in the

urine, which have been washed from the surface of the patches of chronic inflammation left by gonorrhœa long after the end of the acute stage. Gleet is seldom absent from any case of stricture, either of recent origin or of long duration. It is, of course, not confined to stricture, being present in other urethral affections.

The next symptom very often present in the early cases is a little soreness or itching in some part of the canal, felt sometimes after micturition, but also as frequently quite independently of micturition. The pain and itching are not severe, and are never put forward by the patient, however much his attention may be fixed on his gleet, as a matter of consequence. Indeed, inquiry is usually needful to learn the presence of these sensations. But, as these symptoms do not point solely to stricture, the urethra of a patient should always be examined if he has had gonorrhœa at least once, generally twice or thrice, in the last three or four years, and recollects that the discharge continued as a gleet for some time after each acute attack. Very commonly, there will be found, along the tract from the meatus to the bulb, contractions at certain places, which resist the passage of a bullet—sound three or four numbers smaller than the natural expansibility of the canal; if a smaller sound slip past these places, pain is felt by the patient, and perhaps a drop of blood is brushed from the congested or excoriated patch as the sound is withdrawn.

When the stricture has advanced so far that its narrowness obviously delays the outflow of urine, the following symptoms are usually present. In such cases, an interval of from three to eight years has generally taken place between the first gonorrhœa and the patient's application for relief.

The ordinary symptoms are several: among the most usual are diminished size and force of the stream, straining to expel the urine, and increased frequency of micturition. Of the two former symptoms many patients are quite unaware, even when they are well-marked; but, if questioned, they usually acknowledge that the habit has grown on them of passing urine once or twice during the night, between going to bed and rising in the morning. Pain in passing urine is sometimes severe in cases of narrow stricture, but there may be considerable stricture without pain; while pain is a symptom of many affections of the urethra from which stricture is absent. If pain in cases of narrow stricture is felt,

it is generally described as of a 'cutting' character. Occasionally, aching pain in the perineum, a sense of weakness and fatigue or aching in the groins, buttocks, and thighs, are complained of by stricture patients. 'Twisting' or 'forking' of the stream is often present; being caused by the irregularity of the passage, and by the contracted part preventing the impulse of the bladder from driving the urine forcibly through the meatus. But an irregular or slightly narrowed meatus will make the same alteration in the stream, when no contraction is present elsewhere. Hence, 'twisting' or 'forking' is not a very important indication of stricture. A pretty constant symptom is trickling of a few drops of urine from the urethra, after the act of micturition has ceased. Thus, the patient notices that his dress is disagreeably wetted after passing water. This imperfect clearance of the urethra is due to the impediment the stricture causes to the onward flow given to the stream by the perineal muscles, when the bladder is emptied. This symptom is often absent or not noticed by many patients.

In the history of the period between the original cause of the stricture (acute gonorrhœa or wound of the urethra) there often will be found accounts of attacks of retention of urine, complete or partial, which have been overcome by medicine or by instruments. Attacks of feverish disturbance are not infrequent in some persons. These are shown by frequent calls to pass urine; increase of the pain felt while the stream flows; shivering fits, single or repeated, and accompanied by a rise of temperature to 103° F. or higher. On the other hand, none of these symptoms may be so pressing as to attract attention, and the first intimation to the patient of any disorder in his urethra may be a sudden attack of retention of urine, brought on by a fit of debauchery, by exposure to cold, or by excessive fatigue.

The consequences of so serious a disturbance of the working of the urinary apparatus may be readily conceived. As degeneration of the secreting tissue of the kidney advances, so does the nutrition of the body become seriously impaired, and liability to inflammatory affections of a low type greatly increased, among which may be mentioned pneumonia and other consequences of Bright's disease, by which the duration of life is much shortened. Even before these serious affections arise, others less hazardous, but very harassing, attack the patient. He is beset with more

frequent calls to micturate than before, and has always trouble in voiding urine, which varies between a little twinge of pain and severe suffering; while, at any time, a trifling accident may cause swelling of the stricture and jeopardy to the patient's life. If the urethra do not give way behind the stricture, and thus cause urinary abscess, extravasation, or fistula, other less active affections may develop when the kidneys have become greatly deteriorated by long interference with their function, such as cystitis or urethral fever.

The *diagnosis* of stricture, when the condition is advanced, is rendered highly probable by the diminished stream, by its altered shape, by pain or effort in voiding urine, by the trickling away of a few drops of urine after the patient has buttoned up, and by the history of previous attacks of retention. In such plainly marked cases, the question is not then of the existence of a stricture, but of the amount and situation of the contraction.

In cases where the stricture has had only a short duration, and where one slight contraction has taken place, the symptoms being limited to a gleet and occasional itching, the diagnosis cannot be made without exploration of the passage with instruments.

The *prognosis* depends somewhat on the temperament of the patient. A man of nervous, irritable nature is more quickly worn down by stricture than one of placid, easy temper. A far more important condition than the temperament of the patient, is the extent to which the kidneys have suffered. Some evidence of this can be learned by careful examination of the urine, noting the quantity secreted, the amount of urea, the presence or absence of albumen. A third condition of weight is the narrowness of the stricture; another is its situation. Strictures, which involve the bulbous and membranous portions of the canal, are less safely treated than others which are seated in the penile portion of the urethra. If untreated, the consequences of stricture gradually develop and increase in severity, until death is caused by one of the several accidents already mentioned—rupture of the urethra and extravasation of urine, exhaustion by urethral fever, degeneration and acute inflammation of the kidneys, septicæmia, pneumonia, or cardiac disease.

On the other hand, if treated, stricture need not shorten life, and by removing the impediment to micturition, it is possible to arrest the development of the several consequences of that disordered function.

Treatment.—For treating organic stricture there are five methods available—viz. gradual interrupted dilatation, gradual continuous dilatation, forcible rupture or division, internal urethrotomy, and external urethrotomy. In addition to these established methods there are others, such as destruction of the stricture with caustic, which has become obsolete, or by electrolysis, which is not yet of proved practical value.

In all methods of treatment, a permanent cure cannot be achieved unless the stricture be of very recent formation, and the conversion of the inflammatory thickening into contractile material not yet complete.

In the rare cases in which no contraction returns after expansion, the whole of the new product is probably absorbed, and the natural elasticity of the urethra is restored. But when the transformation from inflammatory plastic exudation into fibrous tissue has taken place, the stricture, however completely it may be widened to or beyond the natural dilatability of the urethra, must be expected to shrink again, either slowly or speedily, according to the individual or to the method adopted for its dilatation. Hence, the aim in treating stricture is to expand it to the natural width of the urethra, and to maintain it near to that size by the occasional passage of a sound or bougie.

1. *Gradual interrupted dilatation*—by passing instruments of increasing sizes at short intervals, is the mode applicable to the majority of cases. This method excites the least irritation; it is a simple plan and need not interfere with the patient's ordinary pursuits, while it gives some relief even when that relief is only imperfect and temporary.

The classes of cases to which the interrupted gradual dilatation is most suited are, early semi-inflammatory strictures, and strictures in the bulbous portion, where the kidneys are greatly diseased. In the latter, sufficient increase to the width of a stricture may be given by the passage of bougies to render life very endurable; but, at best, any plan of treatment is unsatisfactory in such cases. After this method of dilatation, whenever the stricture is caused by well-organised fibrous tissue, long intervals between the passage of an expanding instrument are not to be expected. Nevertheless, if he pass his bougie regularly, the patient may enjoy fair health and comfort for the remainder of his life. As a rule, gradual dilatation is useless for bridle strictures, for contraction of the meatus, and

for very dense perineal strictures. These latter obstructions resist dilatation by this method; any attempt to widen them beyond a very insufficient degree will cause great constitutional disturbance, pain, rigors, and high fever, with subsequent prostration. Again, certain strictures shrink back so fast, after dilatation by the interrupted passage of instruments, that no progress is achieved. For all these varieties, incision through them by the knife is to be preferred, since it gives an almost complete cure for the bridle stricture, greatly retards the rate of contraction of the elastic strictures, and, if practised with proper precautions, is less frequently followed by febrile reaction than is any other plan of treatment.

For the interrupted dilatation of strictures three forms of instruments are employed. They are rigid or flexible. The best rigid sounds are made of steel, as steel can be more highly polished than any other material. Silver and plated metal, especially pewter, grow rough or scratched in use. All metallic instruments should be immersed in hot water immediately after use and then wiped dry while hot. Heating them before use often greatly facilitates their passage. Steel sounds should be kept in a wash-leather case. The most useful shape of rigid sounds for dilating strictures is that which, for about eight inches from the handle, is perfectly straight and cylindrical; beyond that the sound should have a curve occupying a quarter of a circle of two and one-third inches in diameter—that is, the curve is one inch and seven-eighths long. The curve should be maintained to the very tip of the sound; and the latter should not be prolonged in a straight run after the curve is passed. A sound of this shape most easily passes through a stricture, and avoids catching against the neck of the bladder before entering it. The sound has a broad flat handle, that the fingers may control the instrument and easily direct the point. The upper surface of the handle, being parallel with the shaft, is at right angles with the tip or 'beak.' This disposition enables the operator to be constantly aware of the direction of the beak when using the instrument. The sound should be of the same thickness from beak to handle, and simply rounded at the point. It is true sounds are used of conical shape—i.e. at the curved portion the calibre increases slowly from the neck till the straight part is reached, the remaining straight portion having the same diameter along its length.

Conical sounds are supposed by those who use them to wedge the stricture asunder

more readily than a succession of sounds of cylindrical shape; but they have the serious disadvantage of not letting the operator feel the progress of the point of the sound, as the resistance of the stricture to the widening part at the curve masks any impediment that is caused by catching of the beak. For this reason conical sounds are dangerous instruments in not very practised hands. 'Bellied' sounds, like conical ones, are brought into use and fall out again from time to time. Their enlargement is confined to the curved part, and the straight part of the stem is slender, in order that, when several strictures have to be traversed, the resistance may be occasioned only by that stricture through which the belly of the sound is actually passing. As rigid sounds are less safe to use and more likely to cause pain and febrile disturbance than are flexible bougies, it is usual to confine their employment to strictures of only moderate contraction, attacking very fine or tortuous ones with pliant instruments.

Flexible bougies of various thicknesses are used for treating strictures by interrupted dilatation. They range between 1 millimètre in circumference and 25 or 30 millimètres. The smallest bougies are made of plaited silk, silkworm gut, catgut, or whalebone. The former materials are the most flexible, and do not fray or get rough, as do catgut and whalebone. Whalebone, which is a good deal stiffer than gut or silk, can be made temporarily supple by soaking it in boiling water for a quarter of an hour. Still, the rigidity and sharpness of its point render the whalebone bougie very apt to catch in a follicle or pocket of the urethra, and come to a dead stop. The best lubricator to prevent the instrument from rubbing or hitching as it enters the canal, and also to prevent the introduction of infectious matter, is 'Lund's oil' (so named after the surgeon who first used it); a mixture of almond oil fʒjss., castor oil fʒss., and pure phenol (crystallised carbolic acid) ʒj.

To prepare the patient for treatment, every source of irritation should be removed. Violent exercise, especially long walks on the days the bougies are to be passed, must be avoided. The digestion should be good, diet plain, and free, or almost so, from alcoholic drinks. The urine should be acid, quite free from blood, and almost so from albumen. If the kidneys or bladder are irritated by the stricture, they must be relieved by rest in bed, warm baths, saline purges, &c. When there is

chronic retention or cystitis, the bladder must be regularly drained by small catheters until the urine is acid and nearly free from pus. Acute urethritis must also be subdued before the dilatation of the stricture is begun. The preliminaries being got over, and the calibre and situation of the strictures ascertained, the urethra is gradually accustomed to the passage of instruments. Not more than two or three sizes should be passed at the same sitting, and, at first, none large enough to be tightly grasped by the stricture. Usually two days should intervene between each sitting. As instruments are most easily passed in the morning, before the patient rises from bed, in difficult cases the operation should be performed at that time. Indeed, if much spasm attend the passages of the instrument, the patient had better keep his bed wholly during the early stages of dilatation. In most cases, it suffices that the patient have the instrument passed immediately after breakfast, before he begins his day's work. The best position for the patient is to lie flat on the back: the risk of fall from sudden fainting is thus prevented, and the muscles and fasciæ are more thoroughly relaxed. If the patient stand up, he should lean against a suitable object, with his legs about one foot apart.

In passing an instrument, there are three localities in the healthy urethra where its point is apt to catch. First, the navicular fossa just within the meatus, to be avoided by directing the point along the floor for the first inch of the urethra; the next is in the bulb, as the instrument approaches the triangular ligament; and the last is in the prostatic portion, before the bladder is reached.

When using sounds, to prevent a hitch at these places, the operator stands on the patient's left, holding the sound steadily but lightly with the thumb and two first fingers of the right hand across the patient's left groin, with the beak pointing downwards; while the penile portion of the urethra is drawn on to it with the fingers of the left hand, lightly holding the penis between them. By this means the point of the sound is gently pushed to the bulb, whence it then has to traverse the curved ascending portion of the urethra. If the right hand, holding the handle of the sound, be carried to the middle line of the patient and gently raised as the sound is pushed along the urethra, until the handle is vertically over the symphysis pubis, and then, in continuation of its curve, depressed till the handle is between the patient's thighs, the

beak will be kept in contact with the roof of the passage all along the urethra. By this precaution, the sound will not depress the urethra at the orifice in the triangular ligament, nor get fixed in the urethra below that orifice, until the handle is depressed between the patient's thighs sufficiently to tilt the point up, to enter the triangular ligament with a jerk and a cry of pain from the patient. This hitch strains the urethra, and may even tear it, by the long leverage which the sound exerts over the parts in which its point is entangled, as the handle is passing through an arc of a considerable circle. Again, in approaching the neck of the bladder, no resistance is felt if the beak be kept from the floor, otherwise the beak catches in the prostate, and, pushing that organ onward, slips into the bladder with another painful, sudden jerk.

These impediments are natural, and being known can be avoided, but the entry to a stricture is not known until discovered by exploration. It has been pointed out that the irregular growth of the fibrous tissue which forms the stricture often diverts the track to one or other side, thus throwing the beginning or 'mouth' of a stricture athwart the proper direction. If the point of the sound catch in this obstruction, it is stopped in its progress; and if force be used with a fine instrument, the wall of the urethra may be penetrated, and the instrument pass between that canal and the rectum, or into the rectum itself. The 'false passage' so made, remains a pitfall for future embarrassment; the immediate result being for the patient great pain and free bleeding, with not infrequently a sharp attack of fever and abscess, and for the surgeon, failure to reach the bladder. When made by the surgeon, false passages usually start from the floor or from the left side; when by the patient operating on himself, on the right side or in the floor. Recollection of this fact will usually enable the surgeon to avoid the wrong route, by keeping the beak of his sound steadily away from the opening, as he approaches the stricture. In difficult cases, by passing the finger into the rectum the position of the catheter in a false passage can be ascertained, and the beak can often be guided along the urethra. Something may be gained by watching the position of the handle of the sound; if the upper surface is directed to one or other side of the middle line, the beak of the instrument is turned from the course of the urethra against or through its wall.

Even when no false passage exists, the position of the entry to the stricture should be sought for methodically, and, when discovered, carefully noted for future guidance. To do this, the beak should be carried along the roof in the first instance, then along the left side, and then along the right side; leaving the floor to the last, as that is the least likely part at which to effect an entrance. If there be spasm which contracts the stricture closely, a hot sound, passed lightly but swiftly down the urethra, will often surprise the stricture and slip through it without being held. Of course, this resource is only available with strictures of fair width, No. 14 or 16 French, as fine sounds are too apt to pierce the wall of the urethra and do serious mischief, if carried swiftly along the urethra. Indeed, so easily is damage done by using fine rigid instruments in the treatment of strictures, that it is best to reserve their use for cases where flexible ones have been tried in vain. The special and important advantage of rigid instruments, is the power which they give to the surgeon of directing the point in any way he chooses. But, as already mentioned, the sound, some ten or twelve inches in length, is a powerful lever, and sufficiently strong to tear the urethra at the perineal fascia, if forcibly raised and depressed when it is not gliding steadily along the urethra. Much practice and delicacy of touch are needed to safely handle fine silver catheters and sounds.

To pass flexible bougies, the steps of the method are at first the same as those for sounds, directing the point against the floor till the fossa navicularis is passed, then pushing it straight onwards. If it catch at any part—usually the floor of the bulb—the bougie should be withdrawn a little, and, while rotated between the fingers and thumbs, again pushed onwards. If the bougie persistently catch at one point, it must be withdrawn and the point given a little twist or bend. On a second introduction the point will not travel precisely as before, and will probably fail to catch where it was checked at the first attempt. It is well to have bougies with points somewhat bent or twisted spirally, in order that, by rotating the stem, the point may be carried beyond the pocket or round the face of the stricture, and so avoid resistance to its onward passage. Also, when bougies with tapering ends fail, those of equal thickness throughout will often pass, especially if a slight curve be given to the bougie by softening it in hot water, then bending it with the fingers, and, while thus held, stiffening the curve

by plunging the bougie into cold water. If the arrest is caused by the bougie being too thick to pass the stricture, and not by its point being stopped at an obstruction, a different sense of resistance is felt. In the former the point enters the stricture, and is so grasped that force is required to extract it. If the point is stopped, the bougie comes away at once or is even partially ejected by the urethra, which, having been pushed towards the bladder, recovers its natural position.

When the bougie or sound has fairly passed the stricture—i.e. its thickest part is introduced into the narrowest portion of the canal—it should be withdrawn at once. No benefit follows the retention of the instrument, unless it remains in the urethra for the rest of the day, when enlargement of the stricture is attained by another process—that which is set in action by tying in the catheter continuously, to be presently described. On the contrary, spasm and pain are often excited by the bougie being left for a few minutes in the urethra. At the next sitting, the process of dilatation is continued by first passing the largest bougie of the previous sitting, and following it up by one or two of greater thickness, according to the readiness with which the urethra yields to the expanding force. This process of interrupted dilatation is carried on until the No. 24 or 25 can be introduced easily. The patient should then be trained to pass one of these sizes for himself, and, when perfect in his lesson, dismissed with the injunction to repeat the operation once a month, once in two months, every quarter of a year—in short, just so often as he finds needful to prevent shrinkage of his widened stricture.

During the course of expansion it may happen that, while the deeper and narrower strictures continue to yield, one near the meatus, or the meatus itself, refuses to expand before the enlarging bougie. The gradual dilatation thus comes to a standstill. This difficulty is got over by cutting these bands till the meatus, or contraction near the meatus, allows a bougie of the size of the unaltered portions of the canal—No. 28 or 29—to pass it. The further dilatation of the deep stricture can then be proceeded with, and the incised obstructions kept open by passing through them a sound of the size mentioned, until the cuts have healed. Again, strictures, where there is copious formation of cicatricial tissue, often yield up to a certain width, too narrow for safety; but any attempt to stretch them beyond this extent causes violent febrile

disturbance, rigors, vomiting, and other signs of renal irritation and congestion. Such strictures must be cut by some of the methods described under URETHROTOMY. Experience shows that in these cases of irritation from bougie-stretching, the speedy division of the stricture by the knife is seldom followed by more than slight rise of temperature, and hardly ever by rigors and high fever, if proper precautions be taken in the after-treatment.

When dealing with strictures of extreme narrowness, through which the urine escapes only by drops, it very rarely happens that an instrument cannot be introduced into the bladder, if sufficient perseverance be exercised. To succeed, it is needful to have a good supply of fine bougies, varying in shape and material, but all of great tenuity down to No. 1 or less of the millimetrical scale, made of the materials, and with points varying in shape, in the manner already described. The more pliable the bougie is near the point, the more likely is it to insinuate itself into the devious path of the stricture. Various manœuvres are also useful. One is to inject a teaspoonful of oil into the passage before the stricture is attacked by the bougie; the oil distends the anterior part of the urethra and percolates along the stricture. In doing this it often opens the little granulation that overlies the mouth of many strictures, and allows the bougie to slip past. In other cases, the bougie will sometimes run in during the act of micturition.

When spasm is readily excited by instrumentation, chloroform should be employed to annul it. But chloroform has the disadvantage of rendering the patient unconscious of the surgeon's proceedings, when his warnings are often of service to the latter in avoiding false passages.

It is useful to pass a silver tube of the size of No. 14 or No. 12 down the urethra as far as the stricture, and push through it the filiform bougie to the stricture. The point of the bougie is thus prevented from catching in pockets or irregularities, before it arrives at the stricture itself.

A still better plan in very narrow strictures, after repeated failures with the fine bougie, is to pass an endoscope-tube down to the stricture, dilating the anterior portion of the urethra as a preliminary if necessary, and so illuminate the face of the stricture. The mouth is generally readily seen, and the filiform bougie, directed by the eye, enters the stricture with surprising facility. See ENDOSCOPE.

Directed by the fact that the mouth of a stricture is generally placed at the side of the urethra, not near the middle of the passage, an American surgeon has invented an instrument called the 'pathfinder.' This consists of a straight tube of the size of No. 20, the further end of which is closed by a disk, that can be made to revolve round the axis of the tube by a screw at the handle. In this disk, away from the centre, is a hole large enough to allow a filiform bougie to pass through it. In use, the straight tube is passed along the urethra until it arrives at the stricture; the disk is then made to revolve slowly, while a long fine bougie is kept continually peeping from the little orifice. As the disk revolves, it carries the end of the bougie slowly round the face of the stricture; and, being thus brought against several parts of the stricture, the fine bougie probably enters the mouth, and can be pushed on through the stricture, when the pathfinder can be withdrawn over it from the urethra. The drawback to this ingenious instrument is that strictures are seldom single. The large tube is checked in its passage to the fine stricture by a less narrow one placed nearer the mouth of the urethra. This of course can be widened by gradual dilatation or incision, and the narrow one got at, but, in practice, cases of such extreme difficulty as to need the aid of the pathfinder are extremely rare.

When the resources of flexible instruments have been exhausted, silver catheters of great fineness may be used. They can be made three or two, or even only one millimètre in circumference. They should be supplied with a well-fitting stylet that runs closely to the end of the catheter, lest its interior be filled with clot or mucus, and the outflow of urine prevented when the stricture has been penetrated and the bladder reached. The outer end of the catheter may be fitted with a mouthpiece, to which a little syringe can be attached. By this syringe a few drops of urine can be sucked from the bladder, and the interior of the tube cleared of obstruction. As these instruments are as sharp as knitting-needles, they must be used with a very light hand, and never driven along the urethra. A very moderate force suffices to push the point through the urethra and cause serious damage.

When, by any means, an instrument reaches the bladder through a very narrow stricture, it should be tied in the urethra until it is loose; then it should be replaced by a somewhat larger one, or the dilatation

be continued by the interrupted method. Even if the instrument be only a bougie, not a catheter, the urine finds its way by the side of the instrument more and more freely the longer the bougie remains.

2. *Gradual Continuous Dilatation.*—This plan consists in tying a flexible instrument in the stricture, and replacing it with a larger one every two or three days, until the natural calibre of the urethra is restored. The change of catheter is needed lest it slip out when very loose in the stricture, and also for purposes of cleanliness. This method occupies about ten or twelve days, and is easy, rapid, and generally safe. It requires a few precautions—(a) the catheter should always be a loose fit; that is, two or three numbers smaller than the stricture; if a tight fit is employed, the patient suffers much from pain and irritation, often sufficient to compel the interruption of the treatment; (b) the patient should be confined to his room, and for most of his time to his bed; (c) the catheter, as it lies in the stricture, should leave the neck of the bladder free. Of course, the catheter must be pushed into the bladder when it is desired to draw off urine, and withdrawn when the bladder is emptied, and its mouth stopped by a little spigot.

The process by which this dilatation is obtained is, probably, similar to that which goes on in parts where a seton or other foreign body has been placed. The fibrous tissue becomes swollen and juicy; its cells enlarge, and the intercellular spaces are charged with leucocytes. The further disintegration of the fibrous tissue into pus quickly widens the contraction, and causes a purulent discharge from the urethra.

The drawbacks to this rapid and easy dilatation prevent reliance on it alone for the whole course of treatment; though for the first stage of widening a very tight stricture it is very appropriate. These disadvantages are—(a) the rapidity with which a stricture enlarged by continuous tying in shrinks back when the process is over; usually so rapidly that the patient cannot keep himself free from danger and discomfort; (b) a few patients cannot support the presence of a catheter in the urethra for more than two or three consecutive days. In such persons, *malariae*, pain at the neck of the bladder, or general febrile reaction, which may be very severe, compels the removal of the catheter and, when subsidence of the irritation allows the treatment to be resumed, the adoption of some other method. Notwithstanding

these disadvantages, tying in is useful when rapid dilatation is needful to drain a bladder attacked with cystitis after long retention, or where the large amount of renal disease renders urethrotomy hazardous.

3. *Forcible dilatation* is a method which seeks to widen the stricture by stretching the fibrous tissue sufficiently at one sitting to restore the calibre of the canal. As fibrous tissue is quite inelastic, 'stretching' really means tearing the bonds asunder slowly instead of ripping them apart instantaneously as in 'divulsion.' To effect 'forcible dilatation' a split sound is used, the halves of which, when lying close together, equal No. 12, but can be separated, for about three inches of their length, by a lever worked by a screw until the width equals No. 26 or more. In use, the sound is passed in its contracted condition far enough for the expanding part to lie in the stricture. The blades are then slowly separated, until in the course of ten or fifteen minutes the strictured part is stretched to the natural expansibility of the urethra.

4. *Divulsion*: the instantaneous ripping asunder of the narrowed part, is effected by a variety of instruments working on the same principle—viz. forcibly separating the halves of a small split sound by thrusting a wedge rapidly between them.

Both forcible dilatation and divulsion have the great disadvantage of being followed by rapid re-contraction, and divulsion is very liable to the untoward consequences which occasionally attend the gentlest instrumentation of the urethra. Indeed, rigors and suppression of urine, with fatal result, are more frequent sequelæ of divulsion than of any other method of treating stricture.

For treating strictures by cutting operations, the reader is referred to the article on internal and external URETHROTOMY.

In reference to the numerous list of complications which may follow any method of widening strictures, it must be recollected that the urethra is of extremely delicate, highly nervous structure, easily damaged or irritated, and that no method is quite free from risk of painful or dangerous consequences. Of the less serious complications are slight hæmorrhage, soreness and pain in passing urine, fainting or syncope, spasm of the perineal muscles, causing more or less difficulty in voiding urine for some hours or days after the passage of an instrument. These symptoms usually subside spontaneously in a few hours without further mischief; but the hæmorrhage, if

the erectile tissue at the bulb be injured, may be so abundant as to greatly exhaust the patient and even endanger his life. The syncope may be attended by more serious nervous disturbance, such as violent vomiting, great prostration, great anxiety and depression of spirits, and copious clammy sweats. The difficulty in micturition from spasm of the deep perineal muscles may amount to total retention of urine. The shock, which sometimes follows even the passage of a bougie over the bulbomembranous portion of the urethra, may cause reactionary pyrexia, showing itself as URETHRAL FEVER or as SUPPRESSION OF URINE. The latter varies from a small diminution in quantity of the renal secretion to the complete arrest of the renal secretion and a speedily fatal termination. The presence of albumen or blood in microscopic quantity in the urine passed during the next few hours, indicates the renal congestion of moderate amount which follows the diminished secretion of urine even when that is but slight. The local troubles are not few nor of light importance. They include inflammation of the testicle, abscess in and around the prostate or perineum, with, it may be, septicæmia as their final termination.

BERKELEY HILL.

STRICTURE-DILATORS. — Under this name are included instruments which act upon strictures in very different ways; some of them are true dilators, but others, of which Holt's instrument for the urethra is best known, really act by rupturing the stricture.

The instruments employed for the rapid dilatation of strictures of the urethra are — conical metal sounds, Wakley's tubes, Thompson's expander, and Holt's and Berkeley Hill's dilators.

Lister's conical sounds are solid instruments made of plated steel; their curve is accurately adapted to the urethra, and their weight and the smoothness of their surface greatly facilitate their introduction; they cause very little irritation, and patients upon whom they have been used often prefer them to soft instruments. The sounds have bulbous ends with narrow necks, beyond which they increase gradually in size until about the opposite end of the curve, where they are three sizes of the English scale larger than at the points. Two, and sometimes three, instruments may be passed successively at one sitting. By this method, which is one of true dilatation, the stricture may, in suitable cases, be rapidly and safely brought up to the full size.

Wakley's dilator consists of a small silver catheter which serves as a guide, and of a series of tubes of gradually increasing sizes. The guide is first passed through the stricture, and then a steel rod is screwed on to its proximal end. Over this, one of the tubes is passed onwards through the stricture, and, when in place, it serves as the conductor over which another and larger tube may be passed, and so on through the whole series until the stricture is sufficiently dilated. It is possible to use this instrument in two ways. One or two tubes only may be passed at one time, and then the effect would probably be one of true rapid dilatation; but if the whole series are successively introduced at one sitting, it is difficult to conceive that the urethra will escape laceration.

Thompson claims for his instrument that it acts by over-distending the stricture — that is, by stretching it to four or five sizes beyond what is natural to the urethra at the part affected, without causing unnatural dilatation of other parts whose normal calibre is less. This instrument is composed of two blades, which can be separated most widely at the desired spot by means of a lever, which is itself worked by turning the handle. It should only be used for strictures situated in the bulbous portion of the urethra, and the blades of the instrument should be slowly separated so that their action may be, as much as possible, one of dilatation, though, undoubtedly, some laceration of the urethra at the seat of the stricture must be caused.

Holt's instrument consists of two blades joined at the extremity, and, lying between them, of a wire, which serves as a guide, along which a tube (No. 12 English scale) may be passed in such a way that the blades of the instrument are rapidly wedged asunder. The two-bladed instrument is first passed through the stricture, and then the wedge is forcibly thrust home, and any resisting bands are ruptured.

Berkeley Hill's dilator consists of a split sound, the halves of which can be separated by passing between them a wedge which is fixed on the extremity of a steel rod. The wedge is dovetailed to the blades of the sound, and seeing that friction only occurs at these points instead of all along the instrument, as in Holt's dilator, the force required to use it is comparatively slight.

Sir H. Thompson and Mr. Berkeley Hill have both abandoned rapid dilatation in the treatment of stricture of the urethra, and there is a widespread belief that rapid dilatation, or, more correctly, rupture of stric-

tures, has in many cases been followed by disastrous consequences. Rupture of a urethral stricture is often followed by intense shock; in many cases suppression of urine has resulted from it; and in others pyæmia has followed it. But in addition to the dangers attending forcible rupture of a stricture, the degree and permanence of relief afforded by it has been less than that gained by other methods of treatment. In fact, the only recommendation of forcible dilatation is the ease and rapidity with which it may be accomplished.

Fibrous strictures of the rectum are commonly treated mechanically by the introduction of bougies of gradually increasing sizes, in combination with, or independently of, notching of the constricting band in a few places; but there is an instrument known as Todd's dilator which is adapted to produce more rapid dilatation. It consists of two blades, which are joined together by four crossbars in such a way that a parallel motion and separation of the blades may be effected by turning a screw in the handle. Before introducing this instrument into the stricture, its blades should be closed and covered with an india-rubber sheath, so as to protect the mucous membrane against being caught between the blades of the dilator.

BILTON POLLARD.

STROMEYER'S CUSHION is used, as a support for the upper limb, in the treatment of compound fractures of the humerus and the elbow-joint. It is a triangular cushion with two of its angles rounded off, and stuffed with horsehair. One of the rounded off angles is placed in the axilla, and the upper limb, flexed to a right angle at the elbow, is laid on the cushion. The cushion is maintained in position by two tapes, which pass from its axillary angle over the opposite shoulder; and by other tapes, which pass round the body from the two lower angles of the cushion. The whole apparatus is supported in a sling.

STRUMA. See SCROFULA.

STUMPS, Affections of.—A stump is said to be a good one when the soft parts are freely movable over the end of the bone, without any redundancy of tissue, when pressure can be borne directly on the face of the stump, and when the cicatrix is not over the end of the bone.

After the lapse of a year or two, a stump will be found to have undergone considerable change. The muscles and soft parts atrophy, and the cut ends of muscles

and tendons have taken up new attachments either to the bone, or to the fibro-cellular tissue of the end of the stump. The bone becomes rounded and the medullary canal closed by a layer of compact tissue, and from disuse it often undergoes fatty atrophy. The ends of the nerves are thickened and more or less bulbous, the swollen ends consisting of fibrous tissue, with nerve-fibres intermixed. The vessels also diminish in size, and their ligatured ends dwindle, until at last they are represented only by fibrous cords as far as their nearest branches. The stumps that undergo least change are those which are formed of skin-flaps only, or those which are obtained by union between a natural bone-covering and the sawn section of a long bone, as in a Pirogoff or in Gritti's amputation at the knee.

Treatment of a Recent Stump.—The dressings should be of some antiseptic form, and great cleanliness exercised in changing them. Rest for the stump is essential, and muscular spasm is best controlled by the application of suitable splints. Efficient drainage must be provided, but the tubes should not be kept too long a time in a stump. In ordinary cases, when the flaps are well approximated, and there is no constitutional disturbance, they may be shortened or dispensed with at an early dressing. When, however, there is a cavity in the stump, as in a Syme's amputation, or in an amputation through the knee-joint, the drainage must be continued for a longer time. Through carelessness, or from not properly securing the ends of the drainage-tubes, a piece may be left forgotten in a stump and give rise to troublesome suppuration.

Hæmorrhage that occurs a few hours after an amputation is best treated by removal of the dressings, elevation, and exposure of the stump to the air. If the oozing seems general, then firm compression may be applied; but if there be reason to suppose that a vessel has escaped ligation, the flaps must be opened, and search made for the bleeding point. This is especially necessary if there be great distension by clot; the removal of all clot, provided proper precautions are taken to maintain an antiseptic condition of the wound, will greatly expedite the reparative process. See HÆMORRHAGE.

Secondary hæmorrhage, at an interval of several days after operation, necessitates careful watching, and often prompt action on the part of the surgeon. If it be small in quantity, the expectant treatment is

indicated, but a renewal of the bleeding, or any excess indicating lesion of a large vessel must be dealt with by careful search for the bleeding point. However unhealthy the condition of the stump, the bleeding vessel can generally be found, and by a little dissection secured. The thorough cleansing and drainage obtained by opening the flaps is often followed by rapid healing. *See* ARTERIES, Wounds of.

If hæmorrhage occur at a later period when the stump is nearly healed, then an incision may be made in the course of the vessel and a ligature placed at a slightly higher point, or the artery may be ligatured at some convenient position as near the stump as possible.

Necrosis of Stump.—From the irritation of the saw, or when the periosteum has been stripped from the bone above the point of section, a limited necrosis of the end of the bone may occur, and delay take place in the healing of the stump until the dead bone has separated. A limited necrosis may also result from the projection of the end of the bone through the anterior flap, secondary to ulceration of the coverings from pressure; occasionally an extensive central necrosis ensues, attended with much constitutional disturbance and profuse offensive suppuration. A considerable time will then elapse before the sequestrum can be extracted, but still eventually a good stump will result. The thickening of the bone by periosteal deposit, and the tenderness elicited by pressure over it, the retraction of the soft parts, the necrotic appearance of the end of the bone, and the escape of pus from the medullary cavity, will make the diagnosis clear. In certain of these cases, but fortunately now of rare occurrence, acute necrosis after amputation is attended with such severe constitutional disturbance and evidence of septic absorption, as to necessitate a higher amputation, and an amputation if possible at the joint above the bone affected. Such a procedure is, however, only justifiable when life is endangered by the septic process, or by the exhaustion produced by prolonged suppuration. *See* OSTEOMYELITIS.

An *adherent cicatrix* may be the result of undue prominence of the end of the bone, or be caused by any of the conditions giving rise to conical stump. Such a cicatrix is often tender to the touch, prone to ulceration, and entirely prevents any direct pressure being borne on the end of the stump. When much inconvenience is occasioned, removal of the cicatrix, if the

parts are redundant and permit of it, will be requisite. In many cases, it will be desirable to take away a sufficient portion of bone with the cicatrix.

Eczema of stump may be induced by the irritation of the dressings, and is apt to take on a chronic course, especially in persons predisposed to it, or when there is an ulcerated condition of cicatrix keeping up continued irritation.

When eczema occurs in consequence of the dressings, boracic lotion should be substituted for any stronger antiseptic that may have been in use.

Painful Stump.—A recent stump may be excessively painful from inflammatory exudation. When acute necrosis occurs, then pressure on the end of the bone, or manipulation during the dressings will occasion the most intense suffering. For the first few days after an amputation through a muscular part like the thigh, the involuntary movements caused by spasm of the muscles are often very distressing to the patient, but can be controlled by the application of splints. The possibility of pain and spasm, due to the inclusion of a nerve in a ligature, must also be remembered.

A stump may become painful, and remain so long after it has healed, and yet nothing be found to explain the condition. The patient is generally a young or middle-aged female of hysterical temperament. Careful search should be made for any point of local tenderness, especially in the cicatrix, since the implication of some nerve-twigs in the cicatricial tissue might be the cause of the condition, and relief be afforded by the excision of the portion of cicatrix involved. In conical, and sometimes in well-shaped stumps, the nerve-ends may become greatly enlarged and painful, so that pressure on them gives rise to a peculiar electric form of pain. The bulbous nerve-ends often constitute a true form of neuroma, and contain numerous nerve-fibres as well as fibrous tissue. Free excision of the tuberos swelling or swellings would then be necessary.

Malignant disease of a stump may be a local recurrence after amputation for malignant disease in the immediate neighbourhood, or epithelioma may attack the cicatrix of a stump that has been the seat of chronic irritation. Re-amputation when possible will, of course, be advisable.

The time at which an artificial limb can be adapted to a stump, will vary according to the particular case and the amount of direct pressure to be borne.

An interval of three months after complete cicatrisation is advisable, and no expensive instrument should be ordered for at least a year. The stump will then have shrunk to something like its permanent dimensions. Amputations at the ankle-joint, and at or through the knee-joint generally, give a stump capable of bearing the whole or nearly the whole weight of the body; but in an amputation through the leg or thigh, no matter how the flaps have been fashioned, the bearing points of an artificial leg must be distributed carefully on the bony points above, and little if any pressure be allowed on the end of the stump. See ARTIFICIAL LIMBS.

Conical Stump.—After amputations through the shaft of a single bone, such as the humerus or femur, the stump generally becomes a little conical in time, owing to the atrophy of the soft parts. In young subjects, with active growth of the bone going on, this condition of stump is sometimes extreme, the end of the bone, covered by stretched skin or thin cicatricial tissue, projecting very much like the stick of a half-opened umbrella; and this may take place in a stump that was originally well-formed.

A stump may become conical owing to the shortness of the flaps, or from the bone not being sawn through at a sufficiently high level, from bad after-treatment, or from the recession of the soft parts during the healing process, especially when this is prolonged, and when the amputation has been performed through parts previously inflamed, or when the patient is in an exhausted, unhealthy condition.

Treatment.—By proper attention to the dressing of a stump, much may be done to prevent its becoming conical. By injudicious bandaging, strapping, or over-manipulation during the dressings, almost any slowly healing stump may be made conical. To correct such a tendency, the limb should be carefully bandaged from above downwards, and in some cases extension by means of strapping may be made on the flaps. Subsequently, if it be found that the bone is very prominent, and especially if there be a troublesome cicatrix adherent to the bone, a sufficient portion of the bone must be removed. This may best be effected by making a dependent incision along the side of the bone away from the chief vessels, separating the periosteum with the soft structures by careful use of an elevator, and sawing through the bone at the desired level; care being taken to protect the soft parts from

injury by the saw. When the conical condition is caused by increasing growth of the bone, it is best to defer operation as long as possible, since the deformity is likely to recur, and further interference is then rendered necessary.

BERNARD PITTS.

STY. See EYELIDS, Diseases of the.

STYPTICS are astringents which are applied, either in the solid form or in solution, to the surfaces of wounds with the object of arresting bleeding; or are taken internally in the belief that they increase the coagulability of the blood, and so are beneficial in cases of hæmorrhage from internal organs.

Styptics act locally in two ways—(1) by stimulating the walls of the blood-vessels and causing them to contract; (2) by combining with the albumin of the blood and forming a coagulum in the mouths of the vessels. It is only the bleeding from small vessels and capillaries that can be checked by means of styptics, and to act efficiently on those vessels the styptic must be carefully applied. The clots should be removed from the wound and the cut surfaces should be mopped dry, and then the styptic should be rapidly applied so that it may come into contact with the blood in the mouths of the vessels—the object being to form a plug of coagulum within them. If the surface of the wound be not mopped dry, the blood will coagulate upon it as a film, beneath which the bleeding will continue.

Styptics can only be recommended as a means of arresting hæmorrhage in quite exceptional cases, since they act injuriously upon the wound. They act as weak caustics on the tissues, and hence tend to produce superficial sloughing; the clots formed in the vessels are not fibrinous, but consist of a combination of the styptic with the albumin of the blood, and in consequence they cannot be such a good medium for the formation of reparative tissues as a healthy clot would be. However carefully, too, the styptic be applied, it is difficult to prevent the formation, on the surface of the wound, of a coagulum which will act there as a foreign body. All these conditions are fatal to union by the first intention, which is, of course, the surgeon's aim in the treatment of wounds. Styptics should, therefore, never be applied to a wound till other less objectionable methods have been tried and have failed. There are, however, certain regions in which it is

impossible to apply other means of arresting hæmorrhage efficiently, and then styptics are of value.

In cases of vesical hæmorrhage dependent on new growths, it may be impossible to arrest the bleeding by other means, and then an injection composed of a drachm of the solution of perchloride of iron to an ounce of water is of much use. In post-partum hæmorrhage from the uterus, if the uterine contractions cannot be provoked, and an injection of an antiseptic solution at a temperature of 105° to 110° Fahr. has failed, an intra-uterine injection of perchloride of iron (one part of the solution of perchloride of iron to three of water) should be tried. Its use is not, however, unattended with risks. In obstinate bleeding after extraction of teeth, when careful packing of the tooth-sockets has failed to check the flow of blood, a plug of cotton-wool soaked in a solution of perchloride of iron often arrests it at once. Hazeline, the active principle of *Hamamelis Virginica*, is a good styptic, and may be employed instead of iron for the last-named purpose. The writer has found hazeline most successful in arresting bleeding in a patient, the subject of hæmophilia, who had, on a previous occasion, a bleeding of such severity and persistence that he had to remain in hospital for some months. In bleeding from leech-bites, in situations where pressure cannot be effectually applied, the hæmorrhage can often be quickly stopped by touching the bleeding points with the solid stick of nitrate of silver. Powdered matico-leaves, tannin, gallic acid, alum, and spirits of turpentine may be enumerated as styptics, and the last-named has many times proved successful in controlling hæmorrhage which has resisted other means of treatment.

Wherever it is possible, styptics should be applied on cotton-wool, which should be fixed in position with firm pressure; but if the bleeding be from an internal cavity, such as the bladder, a soluble styptic must be injected into it. With regard to internal styptics, it is only necessary to state that they are useless in the treatment of such cases of bleeding as are met with in surgical practice.

BILTON POLLARD.

SUBCLAVIAN ANEURISM. — In this class of aneurism are included only those cases in which the innominate artery is not involved; that is to say, it excludes all cases of aneurismal dilatation commencing in the arch of the aorta or the innominate artery, and extending into the subclavian. It also excludes all those

cases in which the dilatation begins below the level of the lower border of the first rib. It is necessary to be somewhat precise in thus limiting the lower level of the subclavian artery, as very different anatomical points are adopted as the seat of its termination, especially by continental writers. Thus Kocher, in his elaborate essay on subclavian aneurisms, makes the artery terminate at the lower border of the pectoralis minor, and therefore includes many cases of what would be ordinarily termed axillary aneurisms. It frequently happens, however, that an aneurism commencing in the subclavian extends downwards into the axillary artery, and to these the term subclavio-axillary aneurism has been applied.

Subclavian aneurism is of fairly frequent occurrence, and is said to occupy, in order of frequency, an intermediate place between carotid and innominate aneurism. Considering the strains to which the subclavian artery must be subjected in the varied movements of the upper extremity, it seems surprising that more cases, the direct result of violence, are not met with. The aneurism may be seated in any part of the artery on the *right* side of the body, or it may occupy the whole course of the vessel from its origin to its termination. On the *left* side it is stated that aneurism only occurs in that part of the artery which is external to the thorax, and that the intra-thoracic portion is never the seat of aneurismal dilatation, except as a secondary result of primary dilatation of the arch of the aorta. The most common situation, however, for aneurism of the subclavian on both sides is in the third part of its course, external to the outer border of the scalenus anticus muscle. The aneurisms are usually of the fusiform variety, and are often of comparatively small size.

Causes.—Aneurisms of the subclavian artery are generally connected with extensive disease of its coats, and also of those of the arteries on the proximal side of the swelling, and to this pre-existing morbid condition of the vessel most of these cases are due. Thus of 121 cases tabulated by Poland, in 33 there were distinct proofs of atheroma, in 14 there was aneurismal dilatation of the aorta, and in 25 the aneurism was stated to be spontaneous and without any history of an injury, and therefore was presumably due to disease of the coats of the vessel. Of 43 cases out of the 121 in which the disease was ascribed to traumatic causes, in 13 atheroma was discovered, in 3 aneurismal dilatation elsewhere, in 23 there was no evidence as to

the presence or absence of atheroma, and in only 4 were the vessels declared to be healthy. It has been stated by some that the much greater frequency with which subclavian aneurism occurs on the right side (in the proportion, it is said, of three to one) is evidence that the disease results in a great measure from traumatic causes, from prolonged or repeated exertion of the right arm, or violent strains of this extremity. But the greater frequency of aneurism on the right side of the body may be explained in another way. The mechanical strain to which the arteries are subjected on the right side of the body is greater than on the left, on account of the larger amount of use to which the right upper extremity is put; and this may be the cause of a more extensive amount of atheromatous degeneration in the coats of the arteries on this side, which renders the vessels more inelastic, and predisposes them to a more frequent occurrence of aneurism on the right than the left side of the body.

The greater frequency of subclavian, as well as of other aneurisms, in the male than the female may be explained in the same way—that is to say, the greater strain to which the arterial system is subjected in the male, on account of the laborious occupations in which he is engaged, renders the arteries more liable to become the seat of atheromatous change.

Symptoms.—An aneurism of the subclavian artery is characterised by a swelling, generally ovoid or fusiform in shape, and usually situated in the subclavian triangle, just above the clavicle, and between the posterior border of the sterno-mastoid and the anterior border of the trapezius. It is often of small size, but may vary from that of a bean to an orange; after becoming diffused, it has been said to attain the size of a football or a child's head. When small, it may disappear behind the clavicle when the shoulder is raised; but generally, when the patient is standing erect in a position of ease, it presents itself as a prominent swelling above the clavicle, and can be distinctly seen to expand at each impulse of the heart. It presents the ordinary symptoms of aneurisms in general, consisting of a circumscribed, compressible swelling, with a distensible pulsation, and having the other characters which are described under ANEURISM. Its pressure effects depend on the part of the vessel implicated. When the disease is confined to the third part of the artery, the brachial plexus and its branches may be pressed upon, producing numbness and sometimes

pain down the arm and in the fingers, with weakness and loss of motion in these parts. There may be also pressure on the subclavian vein, and oedema of the hand and arm may be present. The external jugular vein is also commonly involved and becomes distended and varicose. When the aneurism is seated on the first portion of the vessel, the internal jugular and vertebral veins are pressed upon, giving rise to oedema and lividity of the head and face, and congestion of the brain, producing sometimes a semi-comatose state. It may irritate the phrenic nerve, causing a spasmodic action of the diaphragm; or, on the right side, the recurrent laryngeal nerve may be involved, causing a paralysis of the vocal cord on that side. It may likewise interfere with the trachea or oesophagus, producing stridulous breathing or dyspnoea and difficulty in swallowing, and finally it may press on the clavicle or first rib, causing erosion of these structures.

Diagnosis.—Two points have to be considered in the diagnosis of subclavian aneurism—1st, its diagnosis from other tumours, and 2nd, its exact situation and diagnosis from aneurism in other vessels. The most common swelling for which subclavian aneurism may be mistaken is enlarged glands, which are often found in this situation. The character of the pulsation and the fact that, as a rule, the enlarged glands can be lifted off the vessel, when all pulsation ceases, is generally sufficient to establish the diagnosis. Chronic abscess may also be mistaken for aneurism, and aneurism for chronic abscess; but, by attention to the history of the case and careful manipulation, the true nature of the tumour can be made out. Mayo relates a case, in which an exostosis on the first rib pushed forwards and flattened the subclavian artery, and caused a prominent and pulsating swelling above the clavicle much simulating subclavian aneurism. A subclavian aneurism may be mistaken for a carotid or innominate aneurism, or even for one of the aorta itself, and it is often a matter of great difficulty to ascertain from which of these vessels the tumour springs. A sign of importance, in diagnosing between carotid and subclavian aneurism, is the character of the distal pulse. If the radial pulse is weaker on the affected side than on the other, the aneurism is probably subclavian; whereas, if there is a marked difference in the temporal pulses of the two sides of the body, it is probably carotid.

Prognosis.—At first small, a subclavian aneurism may for some time remain almost

stationary, or only increase very slowly. After a time, however, it augments rapidly, and has a tendency in many cases to become diffused. In the earlier stages, and sometimes even after it has been increasing rapidly, a spontaneous cure may take place. In some of these cases, pulsation suddenly ceases, as if the distal vessel had become blocked, and the swelling subsides; in other cases, there is a gradual diminution in the pulsation and an abatement in the severity of the symptoms, and the aneurism becomes solid and compact. When a subclavian aneurism becomes diffused, it loses its defined shape, contracts adhesions to surrounding parts, and approaches nearer and nearer to the surface. It may burst externally, or into the pleural cavity, bronchi, or trachea. It may cause death from pressure on the windpipe and suffocation, or from irritative fever and exhaustion.

Treatment.—Probably there is no class of external aneurisms in which the surgical treatment is so unsatisfactory and the outlook so gloomy as in subclavian aneurism. All the various means of treating external aneurism have been resorted to, with a very small amount of success and with repeated failures, and it becomes a question whether it is not more expedient to abandon these measures, and to treat the cases on the ordinary principles of internal aneurism, by rest, attention to diet, and medicine. At all events, in the majority of cases the surgeon will best fulfil his duty to his patient by endeavouring, in the first instance, to bring about this condition of so-called spontaneous cure by these means. But should they fail, or should the disease be spreading so rapidly as to preclude any attempt to cure the aneurism in this way, the question of surgical treatment will have to be considered. All the various plans of treating external aneurism have been adopted in these cases: pressure, either direct or indirect, both on the cardiac and distal side of the aneurism; proximal or distal ligature; injection of ergotin into the neighbourhood of the sac; manipulation; galvano-puncture and amputation at the shoulder-joint, have all been resorted to, though with a very scanty amount of success.

1. *Direct pressure*, where the aneurism implicates the third portion of the vessel, has been said to succeed in some cases, and its employment holds out a certain prospect of success. At all events, it can do no harm, and ought always to be tried in the first instance, either alone or as an accessory to proximal or distal pressure.

It may be applied either by means of a weight, such as a bag of shot, or by a leaden cap. It is, however, difficult to apply satisfactorily, and in some of the cases in which a cure has been said to have been effected by these means, there is considerable doubt whether the recovery was not to be attributed to other causes.

2. *Pressure on the Cardiac Side of the Aneurism.*—On account of the position of the artery, compression can rarely be applied in this situation, and it is only in exceptional cases that the artery rises so high as to permit of pressure on its cardiac side. Poland records a case in which it was entirely successful, but this success was mainly due to the 'probable existence of a supernumerary cervical rib, and the unusually lengthened and abnormal course of the subclavian artery.' Acupressure, or direct compression of the exposed innominate artery, has been adopted in two instances by Porter and Bickersteth. In Porter's case the pressure was made after the artery had been exposed, by an instrument resembling a small lithotrite. The patient died on the tenth day from secondary hæmorrhage. In Bickersteth's case the pressure was made by a leaden wire passed round the vessel, and this, by means of a series of india-rubber springs, was made to compress the vessel so as to control the circulation. On the second day the wire broke, and the innominate artery was then ligatured. Death took place on the sixth day afterwards from hæmorrhage.

3. *Distal compression* by itself can hardly be expected to succeed, but may be useful as an adjunct to cardiac or direct pressure. Porter records a case in which the size and pulsation of the tumour was temporarily reduced by compression of the axillary artery, by means of a probe passed under the vessel, after it had been exposed and bridged over by a loop of wire. The benefit was only temporary, and the tumour recommenced growing.

4. *Proximal ligature* is the treatment which has been tried most extensively, but with almost uniformly bad results. Four different operations have been performed—viz. (a) ligature of the innominate; (b) ligature of the first part of the subclavian; (c) ligature of both subclavian and carotid, just beyond their origins; (d) ligature of subclavian, carotid, and vertebral, just after their commencement. To these T. T. Sabine proposes to add a fifth—viz. ligature of the carotid, the subclavian, and all the branches of the latter, except the superior intercostal. The innominate has been

ligatured in sixteen cases, and in every instance but one with a fatal result, and in that the common carotid was also tied, simultaneously, an inch above the bifurcation, and the vertebral artery on the fifty-fourth day, to control secondary hæmorrhage.

Ligature of the first portion of the subclavian has been uniformly fatal in all cases but two, from secondary hæmorrhage. It seems right, therefore, to banish this operation from our means of cure, until some form of ligature can be adopted which will be successful in preventing secondary hæmorrhage.

Ligature of the carotid and subclavian, just beyond the bifurcation of the innominate, has been advocated by some as a means of cure in subclavian aneurism. The object in tying the carotid is to render more certain the formation of a proximal clot in the innominate artery. Probably this end is achieved, but, the branches of the subclavian remaining pervious, so much blood is returned into this vessel as to prevent the formation of a distal clot, and secondary hæmorrhage therefore results. In three cases in which this plan was adopted, the treatment was unsuccessful.

In cases of subclavio-axillary aneurism, or aneurism low down on the subclavian artery, ligature of the second portion of the vessel by dividing the outer half or two-thirds of the scalenus anticus muscle is practicable, and has been followed by good results. Poland records twenty-one cases, of which nine recovered.

5. *Distal ligature* has been resorted to in a few cases, with uniformly bad results, and indeed it seems scarcely possible that any good can be expected from this plan of treatment, which would apparently have the result of increasing rather than diminishing the aneurism. For, between the sac and the ligature are the numerous large branches of the axillary, which would continue to be supplied by blood passing through the aneurism in such quantities as to preclude the chance of any consolidation taking place.

6. *Injection of Ergotin* into the tissues in the immediate neighbourhood of the sac has been employed, and in three cases by Langenbeck has been said to be successful. More extended observation requires to be made before it can be proved that any decided beneficial results are to be obtained from this plan of treatment. It is possible in those cases where recovery has been said to follow this operation, that the cure was spontaneous.

7. *Manipulation* was first recommended by Sir William Fergusson for the cure of

subclavian aneurism. It has been adopted in some few cases, and in one case (Littre's) with the most satisfactory results. The treatment in most of the other cases, even if it has not been beneficial, at all events has done no harm, and it would therefore appear that it undoubtedly deserves a further trial. The cases in which this treatment is most applicable are those where there is a thick sac-wall, pointing to the probability of fibrine having been deposited in its interior, and where the aneurism is easily accessible.

8. *Galvano-puncture* has been tried in these cases, in one instance with success. The result of the same treatment in aneurisms elsewhere is not such, however, as to encourage us to hope for any but the most temporary relief from this measure; though at the same time it must always be regarded as a possible means of cure in cases which cannot be treated in any other manner. See ELECTROLYSIS; ACUPUNCTURE.

9. *Amputation at the Shoulder-joint*.—This formidable measure was first suggested by Sir William Fergusson, as a mode of treatment in cases of subclavian aneurism which are inaccessible to any other plan of treatment, and in which the aneurism is rapidly increasing and evidently must soon terminate the existence of the patient. It must be confessed that this is a desperate measure, since it involves the loss of a most important member (in very many instances the *right arm*), and ought to be reserved for those cases in which it is quite evident that the aneurism is rapidly increasing, and that other means are of no avail; or, in those cases where the limb is gangrenous, or threatens to become so. Certainly, it seems preferable to adopt this measure rather than to resort to any of the formidable operations of ligature of the arteries on the cardiac side, to which allusion has been made, and which have almost invariably terminated fatally.

To sum up. It would appear that in cases of subclavian aneurism an attempt should first be made by rest, careful dietary, and medicinal treatment, to bring about the so-called spontaneous cure. Failing this, if the aneurism is situated in the third part of the artery, direct pressure, and then manipulation, should be fairly tried, since these measures hold out the best prospect of success. If the disease is in the first portion they cannot, however, be adopted; and it may be right to perform the distal operation by tying the third portion of the subclavian, as a preliminary to amputation

at the shoulder-joint. If these various plans have been thoroughly tried, and in spite of all treatment the aneurism is increasing, amputation at the shoulder-joint holds out a better hope of preserving the patient's life and curing his aneurism than any form of proximal ligature, and ought certainly to be adopted.

T. PICKERING PICK.

SUBCLAVIAN ARTERY, The.—

This vessel carries blood to the upper extremity, to the side of the neck, and to the brain. The right vessel starts from the bifurcation of the innominate, the left from the aortic arch beyond the left common carotid. Each artery is divided into three stages by the anterior scalene muscle. The relations of the first stage differ on the right and left sides, but the second and third stages on the two sides are similar.

I. The first stage of the right subclavian passes from the innominate to the inner border of the anterior scalene muscle. It extends forwards, upwards, and outwards from the right sterno-clavicular articulation.

In *front* are the cutaneous structures and the muscles attached to the inner end of the clavicle; but immediately on it are the internal jugular and vertebral veins, the pneumogastric nerve, and sympathetic cardiac nerves. *Behind*, the longus colli muscle, the sympathetic cord, and the recurrent laryngeal nerve. *Internally*, the common carotid artery and the trachea. *Externally* and below, the pleura and the recurrent laryngeal nerve.

The first stage of the *left subclavian* passes from the aortic arch to the inner border of the left anterior scalene muscle; its length is three and a half inches. In *front* are the left lung and pleura; *behind*, the longus colli, the oesophagus, and the thoracic duct; to the *outer* side is the pleura; on the *inner* side is the trachea, oesophagus, thoracic duct, recurrent laryngeal nerve, and the left carotid artery. The pneumogastric and phrenic nerves, and the internal jugular and subclavian veins, converging to form the left innominate, are on a plane anterior to the vessel.

LIGATION.—On the right side the artery is exposed by the same operation as that described for the INNOMINATE. On the left side the vessel is exposed as follows:—Place the patient in the recumbent position; depress the shoulder; make an incision from the sternal notch upward along the inner edge of the sterno-mastoid for a distance of three inches; another, a horizontal incision, is commenced one inch above the lower

end of the former, and carried outwards for a distance of two inches, half an inch above the clavicle. Reflect the flap, with the sterno-mastoid detached from its origin; avoid or tie the anterior jugular vein; divide and raise the sterno-hyoid and -thyroid muscles; with the forefinger feel for the inner edge of the anterior scalene muscle; pull inwards the internal jugular vein. Pass the needle from before backwards—i.e. below upwards—avoid the phrenic, and keep close to the vessel to avoid the pleura.

II. The second stage of the artery is that behind the anterior scalene muscle; in length it is about three-fourths of an inch.

In *front* is the anterior scalene muscle, and on the muscle lie the phrenic nerve, and the transversales colli and humeri arteries. *Behind*, the cord of the brachial plexus formed by the eighth cervical and first dorsal. *Below*, the pleura, and *above*, the brachial plexus.

LIGATION of the second stage is performed by steps almost identical with those for ligation of the third, until the outer edge of the scalene muscle is reached. It is then necessary to cut the muscle for some distance. To do this, feel for the scalene tubercle, pass a director behind the muscle, and nick, or cut it to the extent of half an inch or even two-thirds of its breadth; the danger of cutting too far lies in wounding the phrenic nerve. The lower down the muscle is cut the safer is the nerve.

III. The third stage of the subclavian passes from the outer border of the anterior scalene muscle to the outer border of the first rib. The length is about two inches.

In *front*, are: the skin; superficial fascia with clavicular branches of the superficial cervical plexus of nerves; platysma; deep fascia. The clavicle, the subclavius muscle, the supra-scapular artery, and the subclavian vein run nearly parallel courses in front of the artery. The external jugular vein and the nerve to the subclavius cross it. *Behind* is the middle scalene muscle, separated by the lowest cord of the brachial plexus. *Below*, the first rib and the first serration of the serratus magnus, and *above*, the cords of the brachial plexus.

LIGATION.—Place the patient in the position of repose, with the shoulder depressed. The operator takes his stand between the abducted upper limb and the trunk. Pull the skin down over the centre of the clavicle; cut for a distance of three inches along the centre of the clavicle, severing the cutaneous structures and the platysma. Allow the skin to retract; avoid the transversalis colli

and humeri veins if possible, and open the deep fascia. With a director or knife clear the tissues between the posterior belly of the omo-hyoid and the clavicle. Draw the muscle mentioned upwards; feel for the scalene tubercle and the arterial pulsations, and clearing the front of the artery and opening its sheath, pass the needle, with the left forefinger on the scalene tubercle, from behind forwards to avoid the brachial plexus. It is best to pass the needle obliquely. Difficulties and dangers: (1) Wounding the external jugular vein by cutting too far forwards. (2) Wounding an abnormal cephalic by cutting too far out. (3) Venous bleeding to a great extent from the transversalis colli and humeri veins. Veins, when bleeding, are to be compressed or tied. (4) Finding the omo-hyoid bound down, or attached, to the clavicle. (5) The sterno-mastoid muscle or the trapezius, or both, may require cutting, owing to their wide attachments to the clavicle. (6) Picking up the lowest brachial cord. (7) Wounding the subclavian vein. (8) Difficulty in seeing the needle-end when it is passed, owing to a deeply-placed artery in a short, fat neck, with a high clavicle.

JAMES CANTLIE.

SUBCONJUNCTIVAL ECCHYMO-SIS (Hyposphagma).—The rupture of a small vessel under the bulbar conjunctiva is a frequent occurrence. It suddenly gives to 'the white of the eye' a more or less extensive purple hue, which causes the patient much concern. It is common in old people, but may occur in the young, and even in children, from severe straining, as in hooping cough, vomiting, or raising heavy weights. It is of not the slightest importance, doing no damage to the eye.

Treatment.—If no measures be taken, the extravasated blood gradually becomes absorbed. The process may be hastened by the application of a tight bandage.

H. R. SWANZY.

SUBCUTANEOUS INJECTION. See HYPODERMIC INJECTION.

SUBPERIOSTEAL RESECTION.—Since the beautiful experiments of Ollier, there has always been a fascination for subperiosteal operations, partly on account of the regeneration of bone, and partly on account of the intimate relation which the tendons have with the new bone obtained by this method. But opinion has changed very much as to the desirability of subperiosteal resection in the treatment of joints. There is no mechanical difficulty in

the operation when it is done for disease, for the periosteum, being thick and vascular, peels off very readily from the bone. But, in the case of primary excision for injury, the periosteum is with difficulty preserved uninjured, being in no way distinguishable from a loose connective tissue. In such cases, the amount of bruising and laceration, to which it is necessarily exposed by the use of the raspatory and elevator, defeats the object with which it has been so carefully preserved, and as a consequence the periosteum frequently dies.

First, then, as to *joints*, the advantages of this particular method of excision, even when successfully accomplished, are very doubtful, for the amount of bone that may be and often is thrown out around the new joint will, if excessive, increase the difficulties of obtaining a movable joint. In the knee, where complete osseous ankylosis is desired, there is very little periosteum to preserve, so that, in the only joint in which such new bone would be an advantage, there are no means of doing a subperiosteal resection. See JOINTS, Excision of.

Another very serious objection to this method in the case of diseased joints and carious bones is that, in preserving the periosteum, some risk is run of a return of the disease when the new bone is produced.

Consequently, as far as joints are concerned, this method of operating is not in such general favour as it was some years ago, when first suggested by M. Ollier. And the experience of most surgeons is that the older operation, in which the periosteum is not so carefully preserved, yields as good if not better results than the more tedious and prolonged operation of subperiosteal resection.

In some cases of excision of a joint, a considerable portion of the shaft of a bone may require removal. Under such circumstances, the periosteum should be carefully preserved, to prevent the shortening of the limb that might otherwise occur; but the instances in which this is necessary are very few in number, and do not invalidate the argument that has been previously given as to the objection against the general adoption of subperiosteal resection of joints.

For *caries of bone* this method of removing the disease may be of service, as, for instance, in excision of the os calcis; but there is some danger of a return of the disease, as has been already pointed out. See CARIES, Causes of. But there is not much evidence forthcoming as to this possible result, so that the objection may after

all be a fanciful one. The periosteum is very easily lifted from the bone, and should, as far as possible, be left connected with the tendo Achillis, this connection with the new bone being one of the main objects of the operation.

In *acute necrosis*, this operation will be found of undoubted value. Where the whole or greater part of the diaphysis of a long bone has suddenly become necrosed in acute diffuse PERIOSTITIS (as has been pointed out in the article on that subject), the dead part may be exposed and quickly removed in the earliest stage of the disease before any new bone has been formed by the inflamed periosteum. The long and tedious course of the disease is thereby considerably shortened, and instead of waiting till the periosteum has formed an invaginating sheath, which is the representative of the new shaft, as was formerly the practice, the dead bone is at once removed, and the suppuration thereby reduced to a minimum. A very natural fear has always been entertained that the new shaft would not be of the same length as the old one, even if its thickness and strength were equally good. When two bones exist side by side and only one is affected, as in the case of the tibia and fibula or the radius and ulna, this fear would appear to be groundless; and the experience of many surgeons has proved that, in these instances, the healthy bone maintains the length of the limb while the periosteum of the other is forming new bone. In single bones, such as the femur and humerus, a very large portion of the shaft has been successfully removed before the periosteum has formed its invaginating sheath, and no shortening has been observed. But the writer is not aware that any surgeon has successfully performed subperiosteal resection in the manner above indicated of the *whole* shaft of either the humerus or the femur without a very considerable shortening of the limb.

Transplantation of bone was thoughtfully designed for a case of this kind by Dr. William Macewen of Glasgow, and successfully carried out in 1879 and 1880. The whole shaft of the humerus had been removed from the upper and lower epiphyses by subperiosteal resection, and doubts were at that time entertained as to the integrity of the periosteum. The wounds healed completely in a few months, but bone was only reproduced for about an inch and three quarters from the head of the humerus. From this point down to the condyles it was completely absent, leaving a deficiency of

over two-thirds of the humeral shaft. The arm was therefore to a great extent useless, for there was no fixed point from which the elbow could act. The condition was the same a year afterwards, when the first operation of transplantation of bone was successfully accomplished. Wedges of bone, with the periosteum which covered them, were removed from some cases of deformed tibiae which were at that time under the care of Dr. Macewen, and utilised for the purpose. These were cut into small fragments and inserted in a groove that had been previously made between the muscles of the arm, immediately adjoining the upper extremity of the humerus.

'The former presence of bone was nowhere indicated, and the sole guide as to the correct position into which the transplant was to be placed was an anatomical one.' This operation was performed three times, when the gap was completely filled up. The ultimate result at the end of a year and four months was a most brilliant success, for the bone was firmly united throughout its whole length, and only half an inch shorter than its fellow. See *Bone-Grafting* under GRAFTING.

If transplantation in this way proves on further experience to be as successful as it was shown to be in this case, then there will no longer be the same objection to removal of the whole shaft of a long bone as there appears to be at the present time.

In *amputation* through the shaft of a long bone, periosteal flaps may be advantageously made, a method which is distinctly derived from the other subperiosteal operations. It diminishes the chance of subsequent necrosis of the sawn surface of the bone, covers over any little irregularity of the section, and, by the rapid formation of new bone at the end of the stump, produces a rounded end to the bone more quickly than is obtained by the older method of amputation. After making a circular sweep round the bone, the periosteum may be pushed back with the elevator, and the saw applied. If done in this way there is very little delay, and the operation is not materially lengthened. H. H. CLUTTON.

SUBUNGUAL EXOSTOSIS.—This almost always occurs on the great toe, arising with a sessile base from the last phalanx. It is common in early life, and more frequent in girls. Its structure is that of spongy, cancellous bone, tipped with a layer of cartilage. Its size is usually that of a small currant. As it occasions, if allowed to persist, much inconvenience in

walking, it should be removed early, and completely as well, otherwise recurrence and sarcomatous changes are very likely to occur. Ether being given, and as much of the nail removed as will thoroughly expose the exostosis and its base of origin, a deep groove is to be cut round the exostosis with a small, strong-backed scalpel, and removal completely effected with fine-cutting bone-forceps. The foot should be kept quiet for a few days on a back splint, and one of the following dressings made use of: iced lead-lotion, carbolic oil (1 in 40), or a saturated solution of boracic acid applied by means of two thicknesses of lint, the deeper one of which is only removed once in twelve hours, the other being resoaked and re-applied every two or three hours.

W. H. A. JACOBSON.

SUPPOSITORIES are preparations of drugs, which are moulded in the shape of small cones suitable for administration by the rectum.

The Pharmacopœia authorises suppositories containing morphia, lead and opium, tannic acid, mercury, carbolic acid and iodoform; but many other drugs may be advantageously administered, in the form of suppositories or pessaries, which differ from suppositories only in their larger size, and in being used in the vagina instead of in the rectum.

Cocoa butter is very frequently used as the menstruum for suppositories; it melts quickly, and so the full effect of the drug which it carries will be quickly obtained. Curd soap is ordered in the Pharmacopœia for tannic acid and carbolic acid suppositories. Morphia suppositories are directed to be made either with cocoa butter or curd soap. Curd soap dissolves slowly, and so the local effects of drugs mixed with it will be more prolonged. Suppositories may also be made of gelatine and glycerine, in the proportion of one part of the former to four of the latter.

Nutrient suppositories may be efficiently and easily made in either of the following ways:—1. Take equal weights of concentrated peptonised milk and cocoa butter; warm the cocoa butter in a mortar and mix the peptonised milk with it; then divide and mould the mixture into suppositories weighing a drachm and a half. Each suppository will be equivalent to about an ounce and a half of milk. 2. Take equal parts of Koch's meat peptone and cocoa butter; warm the latter and mix the peptone with it, and mould the mixture to the required shape.

Rectal medication is useful when, from any cause, medicine is rejected by the stomach, or when the local effects of the drugs are required.

Suppositories may be either anodyne, purgative, astringent, disinfectant, or nutritive. Morphia (gr. $\frac{1}{2}$) and belladonna (gr. $\frac{1}{2}$ to 2) are the most useful anodynes; but if their employment be objectionable, iodoform suppositories (gr. v.) will often be found useful. After operations on the rectum, anus, urethra or bladder, the introduction of a half-grain morphia suppository into the rectum is followed by great relief from both pain and spasm. A similar suppository is very valuable for allaying the pain consequent on disease of the surrounding organs—e.g. in acute cystitis with strangury and in painful chordee.

The introduction of a piece of soap into the rectum is a well-known popular remedy for constipation. Suppositories containing aloine (gr. j.), elaterium (gr. $\frac{1}{2}$), gamboge (gr. v.), or podophyllin (gr. j.), may, in suitable cases, be employed as rectal purgatives.

Astringent suppositories may be employed for catarrh or simple ulceration of the rectum or vagina, and disinfectant ones may be serviceable in malignant ulceration of the rectum or uterus, &c.

Nutrient suppositories offer no advantages over nutrient enemata, except the ease with which they may be administered. In introducing a suppository into the rectum, it should be oiled and pushed well beyond the internal sphincter; a little support should be maintained for a few seconds until any reflex contraction of the rectum has subsided. When the sphincter ani has been divided, as in the operation for fistula, the suppository must be passed well up into the rectum, and the anus must be supported by a pad and bandage.

BILTON POLLARD.

SUPPRESSION OF URINE, or the failure of the kidney to secrete—also spoken of sometimes as anuria—is produced in several ways. It may be due to chronic organic disease of the glandular portion of the kidney or to disturbance of its innervation or vascular supply, or, finally, to sudden obstruction of the ureter, leading to complete arrest of its functions. The first of these causes is easy to understand: the organ has more or less gradually undergone fibroid change, as the result usually of one or other form of interstitial or catarrhal nephritis; but of the other two it is not easy to speak definitely. This much, however, may be said, that whether we speak of disturbances of

vascular supply or of innervation, the immediate cause of the suppression of urine has been found to be, in many cases verified by necropsy, an intense congestion of the kidney; in other rarer cases it is probably anæmia of the organ. Thus, in the acute fevers, such as scarlatina, where anuria has proved a fatal symptom, renal congestion has been observed, probably in this case due to the direct action of the morbid matter of the disease upon the renal capillaries; this seems the more likely when we remember that the same effect is produced by overdoses of turpentine, acetate of lead, or the mineral acids. In all these instances the deeply congested organ is unable to excrete more than perhaps a few drachms of dark, highly concentrated and blood-stained urine as long as the hyperæmia lasts. But, in suppression from severe shock to the system after injuries, the matter is not so clear, and requires further study; possibly in these cases anæmia of the organ is the cause. The difficulty surrounding these questions is much enhanced by the fact that the amount of blood found in the kidney *post mortem* seems to vary considerably within the range of health, the organ sometimes looking very pale or turgid where we have no grounds to suspect morbid change.

One form of disturbance of innervation producing suppression, not infrequently met with, gives us, perhaps, a clue to the whole question, and this is the effect upon the kidney of violence to the urethra. Every surgeon is familiar with the fact that after operations upon the urethra ranging from the simple passing of a catheter to bursting of a stricture, or internal urethrotomy, more or less complete suppression of urine is seen from time to time, and this in the healthiest individuals. In these cases the patient may not secrete more than a few drachms of high-coloured blood-stained urine for many hours after the operation, and may exhibit much constitutional disturbance; he may even die unrelieved. If this be so, we find nothing but intense congestion of the kidneys to account for the anuria. Nothing appears to account for these phenomena so fully as the theory of reflex vaso-motor disturbance of the organ; but the exact mechanism of the change requires further study.

In the case of suppression from sudden blocking of the ureter by a stone or fragment of growth, the effect upon the kidneys appears to be practically the same. Only a few drachms of urine are found in the ureter and pelvis; but this urine is usually clear, pale, without albumen, deficient in urea, and

of low specific gravity. The kidney in some of these cases is found enlarged and deeply congested, in other cases anæmic and mottled, and not larger than usual. It is somewhat hard to reconcile these differences, but it may be that both the congestion and anæmia are merely the result of different stages of the same reflex disturbance of nervous balance in the kidney, due to stretching of the urethral walls from sudden impaction of stone, just as in the case of violence to the urethra.

The *symptoms* of suppression of urine are usually very trifling until several days have elapsed. Gastric disturbance, loss of muscular vigour, and insomnia are often seen early; but the characteristic evidences of uræmia are often delayed until perhaps a week has elapsed. When they once appear they become intensified, and death takes place in a few days, usually from the ninth to the eleventh. The characteristic signs of uræmia are muscular twitchings, contraction of the pupils, loss of muscular power, and, as a consequence, laborious breathing. Insomnia is usually very distressing, but coma and convulsions are exceptional; diarrhoea and vomiting are rare unless produced artificially; anorexia is only a very late symptom. The skin often acts profusely, and there is no dropsy or ammoniacal odour from the surface of the body or breath; the pulse has a tendency to rise, and the temperature to fall, as also the respirations (Roberts).

The *prognosis* where suppression is extreme is very bad. Cases are known to have recovered where it has lasted for seven or even fifteen days, but death takes place in the majority of cases before the eleventh day.

The *treatment* of suppression of urine depends of course upon the cause. It resolves itself into local and general. If due to chronic interstitial change, but little can be done locally beyond protecting the loins from sudden changes of temperature. The general treatment will embrace warm baths or vapour baths, the use of pilocarpine and all other measures promoting excretion from the skin; laxatives may also be cautiously employed, but not diuretics as a rule. The diet should be light, consisting chiefly of milk; stimulants should be very cautiously used. Where we have reason to suppose that anuria is produced by renal congestion, wet cupping over the loins, or bleeding from the arm in strong individuals, and dry cupping in the anæmic are most valuable. These measures should be followed up by hot belladonna fomentations over the loins

and abdomen and the general treatment recommended above. The use of instruments should be avoided as far as possible. Where suppression follows upon the impaction of a stone in the ureter, the treatment is directed in the first place to efforts to relax the contraction of the ureter by antispasmodics—as belladonna, chloroform, or even opium used cautiously, together with hot baths of one kind or another. In the second place an attempt should be made to dislodge the calculus by mechanical means, i.e. by placing the patient's body in various positions while kneading over the track of the ureter is practised with the hand: the patient may also be encouraged to active exercise. If these measures fail and the evidence of the presence of a stone is clear, it may be justifiable to cut down upon it from the loin, and either extract the stone or establish a urinary fistula in the flank, if the former be impracticable.

ARTHUR E. BARKER.

SUPPURATION.—Inflammation is said to terminate in suppuration when the exudation is sufficiently corpuscular to form a yellowish fluid—pus. This may escape from a mucous or cutaneous surface, or an open wound; or it may accumulate within an organ or natural cavity—e.g. a joint—in the form of an abscess.

In the case of interstitial inflammation, it is generally conceded that the whole or greater part of the pus is composed of migrated leucocytes and liquor sanguinis; that, in fact, the connective-tissue corpuscles, instead of responding to the irritation by proliferating, remain perfectly passive throughout the entire process. On the other hand, it seems clear that, in catarrhal inflammation of the skin and mucous membranes, the epithelial cells—which, by the way, are physiologically subject to perpetual growth and multiplication—furnish a by no means inconsiderable number of the cellular elements of pus.

There are several circumstances, one or more of which determine suppuration, and favour its continuance when established.

(1) *The degree of injury* to the vessels must be such as to entail exudation of plasma and leucocytes, too copious for the lymphatics to carry off the surplus beyond what can be accommodated by the tissues, consistently with the maintenance of their vitality. If the irritation be too great, stasis rapidly supervenes; the blood coagulates in the vessels, and acute interruption of the exudation ensues. The tendency then is to gangrene.

(2) *Continuation of the irritation.*—A tissue, especially if previously healthy, may be able to withstand a severe injury, and quickly recover from the effects of it, provided the cause be at once removed. On the other hand, if it be allowed to act indefinitely, the power of resistance becomes less and less; the walls of the vessels are so damaged, and the circulation hampered by the pressure of the exudation, that resolution of the inflammation may be impossible.

(3) *The entrance of air* into a wound is a very important factor, as the records of clinical surgery abundantly prove. This is nowhere better exemplified than in fracture of the bones. Even comminuted *simple* fractures habitually unite without the occurrence of suppuration; whereas pus-formation is the rule in compound fractures, and a certainty if the wound is allowed to remain open and unprotected by antiseptic dressings. It is not merely the entrance of air, as that in itself is not harmful, but the admission of organisms contained in the atmosphere, organisms which possess the property of setting up fermentative changes in the products of inflammation. There is thus added to the mechanical injury the irritation by decomposed organic matter. Conversely, the inflammation may be reduced, and, it may be, entirely subdued, by arresting these putrefactive changes.

(4) *Tension* exerts a potent influence on the course of suppuration. It is well known that, so long as an acute abscess remains closed, the signs of inflammation continue unabated. When it bursts or is opened, they subside with surprising quickness. The improvement is not confined to the local lesion, for the constitutional disturbance—the fever—shows at the same time a corresponding decline in intensity. The higher the tension the greater the febrile symptoms and the pain; hence, the importance of the early evacuation of abscesses situated beneath resisting structures like the periosteum, dense fasciæ, &c.

(5) *Friction* is another cause of retarded healing of suppurating wounds. Ulcers of the leg, e.g., continue to secrete pus whilst the dress is permitted to fret the granulating surface. The obstinacy with which sinuses remain open for want of rest and apposition of their walls is proverbial.

(6) *The constitutional condition* of the patient and the *state of local nutrition* must not be neglected here. The result of any injury to a person in good health, and one reduced by acute disease or the subject

of profound cachexia, will be widely different. Depressed vitality, general and local, is at once the cause and consequence of continued suppuration; hectic fever, e.g., whilst it indicates prolonged discharge of pus, tells against the chances of repair of tissues. The cicatricial formation in the wall of a chronic abscess, by diminishing the vascularity, offers an effectual bar to the growth of vigorous granulations.

Scrofulosis greatly increases the pyogenic tendency, and thus underlies the development of suppurative fever.

In *diffuse interstitial suppuration*, the lymph or granulation-tissue melts away so rapidly that there is no chance for limitation of the action of the irritating products; whereas the walls of an acute local abscess, although being continually changed into pus (Billroth), offer a greater resistance to the absorption of irritant matter.

In the so-called pyogenic membrane, or suppurating zone of an acute abscess, the granulation-tissue contains only the remains of the old vessels. So long as suppuration is going on, there is only destruction. New-formed vessels are evidence of repair.

Pus, the anatomical product of suppuration, varies in composition according to the rate at which it is secreted, and the tissue in which it is formed, and whether or not it has been exposed to the air. Healthy, laudable pus, e.g., from an acute abscess, is a creamy, yellowish, somewhat viscid fluid; specific gravity 1,030 to 1,033. It contains about 88 per cent. of water, and a little over 8 per cent. of albumen. The latter fact should be borne in mind when considering the existence or extent of albuminuria in cases of 'pus in the urine.' Traces of leucin, tyrosin, and other products of the dissolution of proteid matter are present. It is rich in chloride of sodium, and is alkaline in reaction. Liquor potassæ forms with it a gelatinous mass. If allowed to stand, it divides into two strata, the upper a clear fluid—*liquor puris*—the lower a yellow sediment. On microscopical examination, it is seen that the deposit consists mainly of opaque corpuscles $\frac{1}{2500}$ to $\frac{1}{2500}$ inch in diameter. They are granular from the presence of fatty and albuminoid particles. Acetic acid clears up the latter and brings into view the nuclei, two or three in number. Some of the corpuscles contain only one nucleus, and resemble leucocytes in every way, their nuclei being visible, as a rule, without the aid of reagents. The fat-granules can be dissolved from pus-cells by ether or liquor potassæ. The cor-

puscles of Gluge are merely inflammatory cells swollen and crowded with granular fat. Cornil and Ranvier refer the multiplication of the nucleus to a vital process; others look upon it merely as the result of disintegration after the death of the corpuscle. Pus-cells are devoid of a capsule.

The pus from a closed acute abscess contains *micrococci*, which are incapable of setting up putrefaction. Rod-shaped *bacteria* are found in abundance in pus that has been exposed to the atmosphere; they are the active agents of septic decomposition. In some cases of infective septicæmia, longer rods, *bacilli*, are met with.

Pus-corpuscles may be pigmented by the colouring matter of the blood, when hæmorrhage has taken place into an abscess or wound. *Blue pus* owes its peculiarity to the presence of *micrococcus cyaneus*, a fungus not found in the contents of a closed abscess. The pus from cerebral abscesses is usually of a greenish tint.

FLUIDS RESEMBLING PUS.—(1) *Disintegrated, liquefied, decolorised blood-clot*. This was mistaken as the proof of suppurative endophlebitis, until Goodsir exposed the fallacy. (2) *Atheromatous matter*, which consists largely of the fatty débris of degenerated cells and cholesterine plates. (3) *Turbid serum*, which in reality is serum charged with pus-corpuscles, endothelial cells, and, it may be, films of fibrin. It is furnished by the serous membranes, pleuræ, &c. (4) The secretion obtained *post mortem* from the Fallopian tubes and renal papillæ. The creamy appearance is due to fatty epithelial cells. (5) *Inspissated milk*, like that composing a galactocoele.

PUS FROM A CHRONIC ABSCESS has often the unpleasant odour of the fatty acids. It varies in consistence from serum to firm cheesy matter; when thin, the fluid portion holds in suspension flocculi of fibrin, fat-granules, very few cells, crystals of cholesterine, and it may be of hæmatoidin and stearic acid. There may be shreds of necrosed tissue. When the suppuration is connected with bone, lime-salts are in excess, and minute sequestra are sufficiently common. Finally, inspissated pus may undergo calcareous infiltration. Microscopical organisms are absent.

The pus from a *gouty abscess* is gritty, being laden with needle-shaped crystals of *urate of soda*. AUGUSTUS J. PEPPER.

SUPPURATIVE FEVER.—Fever is not an essential concomitant of suppuration, for it is usually absent during the formation of a chronic abscess, and there is

no pyrexia associated with the discharge of pus from a healthy granulating wound.

PRIMARY SUPPURATIVE FEVER, such as occurs in the course of an ordinary acute abscess, is not infective; nor is it due to absorption of the products of putrefaction. The pyrogenous matter taken up from the seat of suppuration is incapable of multiplication in the system.

The body temperature rises to about 103° F., but there are no steep fever curves, the morning remission being usually 1°. It remains at its height until the matter is discharged, when it suddenly falls, and soon reaches the normal, if there be ample drainage and the cavity be protected from infection. The relief from the high tension checks absorption. If the fever be high and the abscess large, the patient may experience chills or even severe rigors.

SECONDARY SUPPURATIVE FEVER.—*Hectic fever* is septic, but not infective. The proximate cause is absorption of decomposing—not necessarily putrefying—pus, charged with bacteria. Exceptionally, it follows close in the wake of primary traumatic or primary suppurative fever, but far more frequently it is the consequence of long-continued absorption of septic matter in small doses. It is seen to perfection in the disintegration of the walls of large open abscesses, especially where drainage and disinfection of the discharges are difficult: hence its connection with bone-disease—e.g. caries of the spine, and suppuration in the joints. Constitutional debility is largely concerned in its incidence and progress. Hectic fever is absent so long as a chronic abscess, however large, remains closed. See **HECTIC FEVER**.

Symptoms.—The fever is remittent in type. The temperature, which in the evening is 103° F., or even higher, may fall to the normal in the morning. There is a tendency to regularity in the diurnal variation, so that the register is a series of steep curves. The general symptoms, which are more marked in the evening, are those of exhaustion. The want of tone in the vasomotor system is evinced by the flushed cheek, profuse sweatings, and soft rapid pulse. Lithates are deposited in the urine. The patient's strength is further depleted by colliquative diarrhoea. There is great muscular weakness and rapid emaciation. The pupils are dilated and the eyes glistening. In fatal cases death takes place from asthenia.

The *prognosis* is always grave. It is worse in scrofulous subjects, and in all cases

where it is impossible to remove the cause of the suppuration.

Treatment.—The indications are (1) to secure free escape for the pus; (2) to render the pus aseptic; (3) to check excessive secretion from the skin and bowels; (4) to support the strength by nutritious, easily digestible food, tonics—of which quinine is the best—and alcoholic stimulants in quantity proportionate to the degree of exhaustion; (5) to prevent the formation of bed-sores. For the profuse sweating belladonna is the appropriate remedy. When the temperature is high, tepid sponging affords decided relief. But chief reliance must be placed in quinine given in 5- to 10-grain doses.

AUGUSTUS J. PEPPER.

SURGICAL FEVER.—The various forms of pyrexia, which occur in 'surgical' disorders, are sometimes grouped together under the title of Surgical Fever. The employment of this term, however, is obviously disadvantageous, as unwarrantably involving the assumption that there is a difference of kind in the pathology of pyrexia met with in 'surgical' cases, from that which characterises most 'medical' ailments.

The following are the varieties of pyrexia which are met with in practical surgery:—

1. **SIMPLE TRAUMATIC FEVER.** See **TRAUMATIC FEVER**.

2. **ASEPTIC FEVER.** See **ANTISEPTIC SURGERY**.

3. **SEPTIC FEVER (q.v.)**—(a) *Sapraemic Fever*, see **SAPRÆMIA**; (b) *Septicæmic Fever*, see **SEPTICÆMIA**; (c) *Pyæmic Fever*, see **PYÆMIA**.

4. **NEUROTIC FEVER**, including **URETHRAL FEVER**.

Pathology.—Considering the want of exact information on the subject of heat-production in the body, and considering how little is known of heat-regulation under *pathological* conditions, it would be out of place here to review the various theories, of more or less problematical value, which have been devised to explain the well-known process of fever. In view, however, of the paramount importance of the subject as essentially a practical one, the general notions on the subject, which prevail at the present time, will be here enumerated.

The *process of fever* presents the following phenomena:—

(1) There is increased tissue-destruction (oxidation or combustion).

(2) As a result of this there are the following changes:—

Physico-chemical.—(a) Increased production of heat; (b) increased production

of waste products; (c) degenerative changes in tissues.

Functional.—(d) Acceleration of heart-rate; (e) acceleration of breathing rate; (f) vaso-motor contraction and relaxation of arterioles, formation of rash, &c.; (g) increased secretion; (h) diminution of assimilative power; (i) clonic spasm (*see* RIGOR); (j) diminution of mental power and production of delirium.

The above familiar facts require no explanation or amplification, and it only remains to notice, in addition, the condition known as *hyperpyrexia*. This state, which to outward appearances is simply an exaggeration of ordinary physico-chemical change, shows itself symptomatically by a rapid rise in the temperature, and leads, unless adequately treated, to a fatal issue. Its causation is more obscure than that of simple fever, since it occurs under circumstances where, apparently, no change has been observed in the condition of the patient.

Etiology.—Little can be said of the etiology of the febrile process in general, seeing that it necessarily differs according to the exciting cause in each instance; but, as far as individual peculiarities go, it appears that age plays an important part in determining the intensity of the process to some extent. As might have been expected, the tendency to perversion of the balance between the production and regulation of heat is greatest at the time when the metabolic processes are most active; for this reason it gradually diminishes with age. It is uncertain whether sex and other conditions really influence the febrile process; but race does seem to cause a predisposition to it, especially where the causation can clearly be traced to changes in the nervous system.

Causation.—Fever may be caused by—(1) Lesions of the nervous system. *See* NEUROTIC FEVER. (2) Absorption of specific poisons called contagia. (3) Absorption of certain chemical substances.

At the present time (having regard to the alterations in the bodily functions produced by fever), it is generally believed that the above causes of fever act by influencing the central nervous system, so (a) increasing heat-production directly, or (b) removing inhibitory action over the degree of tissue-metabolism. This belief, which practically assumes the existence of heat-centres governing the production of heat by regulating both tissue-change and vascular capacity, is supported by many facts of clinical experience which need not be detailed here.

Symptomatology.—For any special points not enumerated in the list of symptoms of fever sketched above, the various articles on each variety of fever must be referred to.

Treatment and Prognosis.—The details of both treatment and prognosis of fever, as seen in surgical cases, will be found under the headings enumerated at the beginning of this article. VICTOR HORSLEY.

SURGICAL KIDNEY. *See* PYELONEPHRITIS.

SUSPENDED ANIMATION may be defined as a condition in which all the coarser manifestations of life are in abeyance; in which the patient is motionless and senseless, with arrested respiration, and scarcely any recognisable evidence of the heart's action.

An exhaustive treatise on the subject should include a discussion on the hybernation of animals, and those other conditions in which the arrest of animation consists mainly in the stoppage of the mental faculties, as is seen in coma, sleep, the mesmeric trance, and some forms of melancholia; but, in a practical work like the present, it is necessary to confine our attention to those forms of suspended animation which the surgeon is called upon to treat.

These are *two* in number—viz. *syncope* and *asphyxia*.

SYNCOPE, or fainting, is brought about by failure of the blood-supply to the brain. Such failure may be due to causes situate in the heart itself, as anæmia, or fatty degeneration of the cardiac muscle, or valvular disease; or the heart may fail from faulty or perverted innervation, brought about by causes acting through the mind (such as fear or the sight of blood), or through the body, such as an overcharged stomach or a sudden injury. These are examples of reflex action in which a peripheral irritation, whether bodily or psychical, causes inhibition of the vagus by acting through the centre of origin of that nerve.

Again, the causes of syncope may be, as it were, mechanical, and the blood may fail to reach the brain because its course has been diverted, either by hæmorrhage, whether external or internal, or by the dilatation of the abdominal vessels, as occurs in conditions of shock, and especially in sudden injuries to the abdomen. Usually the conditions which produce syncope are mixed.

The *symptoms* of syncope are giddiness and pallor; the face becomes pale, the fore-

head often beads with perspiration, and the patient, who is usually warned by a feeling of faintness, giddiness, or nausea, falls insensible. The pupils are often dilated, the pulse can scarcely be felt, or may for a few seconds be quite imperceptible, and the sounds of the heart are exceedingly weak. Recovery usually commences immediately, and as soon as the patient is laid horizontal there is a slow gasping inspiration, followed by a return of consciousness. When syncope proceeds to a fatal issue, the respiratory acts become very laboured, and death is usually preceded by a fit of convulsions.

The *treatment* of a fainting fit consists in keeping the patient horizontal, so as to favour the circulation through the brain and tax the strength of the heart in the least possible degree. Take care that the circulation and respiration are not impeded by any constricting bands round the neck or waist, and, if necessary, loosen the clothing at the neck and undo the stays. Admit fresh air in abundance, but, at the same time, take care that the patient is not chilled. Let him be covered with wraps and keep the feet warm. The respiration may be encouraged (and the circulation indirectly) by dashing cold water on the face and upper part of the chest, but the greatest care must be taken that the patient is not made unnecessarily wet, and that the damp clothing is dried as soon as possible. These measures are all that is required in an ordinary fainting fit, and, if the patient be left undisturbed for half an hour, recovery will be complete. It may be advisable to give some stimulant, and a small quantity of brandy or sal volatile mixed with water (hot water is best) will increase the vigour of the heart's action. If the faint be prolonged and the signs of recovery delayed, and if the patient cannot swallow, no time must be lost in giving a stimulating enema of an ounce of brandy, or in injecting ammonia hypodermically (twenty to thirty drops of Sp. Ammoniae Co.).

ASPHYXIA is a state of suspended animation, which is primarily due to a failure of the respiratory functions—i.e. the oxygenation of the hæmoglobin of the blood. This may be caused—

1. By the non-admission of a sufficient supply of oxygen to the lungs, or by the inhalation of a gas incapable of oxidising the hæmoglobin, such as carbonic acid, carbonic oxide, or sulphuretted hydrogen. This accident is usually brought about by the closure of the air-passages, as in strangling or throttling; or by the impaction

of foreign bodies in the larynx or trachea, or the compression of the trachea by foreign bodies in the œsophagus. The inhalation of gases unfit for respiration is an accident which happens to well-sinkers, brewers, sewer-men, night-men, and occurs in one form of suicide—viz. by the inhalation of charcoal fumes.

2. Asphyxia may be brought about by a failure of the respiratory apparatus. In fractures of the spine above the origin of the phrenic, the immediate cause of death is asphyxia. In poisoning with curara or strychnia, the respiratory muscles are rendered useless by paralysis or spasm, and asphyxia results. During the inhalation of chloroform, asphyxia is one of the dangers, caused apparently by the failure of the dilators of the glottis (the crico-arytænoidei postici) to contract in unison with the descent of the diaphragm. If both pleural cavities be opened, then the respiratory machine fails to work, and asphyxia results. Again, compression of the chest, as in crowds, or when persons are covered with falling earth, may lead to asphyxia.

3. The most common cause of asphyxia is drowning, in which water takes the place of air in the higher respiratory passages, and effectively prevents the oxygenation of the blood.

The term *asphyxia*, which literally means pulselessness, has been cavilled at as inappropriate, and the word *apnœa*, or breathlessness, has been proposed for the condition of suspended animation from respiratory failure. The latter term has, however, been used by physiologists to denote a condition of arrested respiration from the excess of oxygen in the blood, and has, therefore, been discarded in favour of its older rival.

The *symptoms* of the asphyxial condition may be shortly stated. At first there is great anxiety, and the want of oxygen in the blood and tissues causes great efforts to breathe, and, the respiratory centre in the medulla being over-stimulated by the venous blood, the extraordinary muscles of respiration come into play. Insensibility quickly supervenes and the skin becomes livid. The lips and finger-tips get distinctly blue, the conjunctivæ are injected. The eyes are bright and protruding, and the pupils usually large. Sometimes there are general convulsions. The pulse is at first quickened, and then fails.

The rationale of the asphyxial condition is said to be as follows:—The blood not receiving its supply of oxygen, and being unfitted for the needs of the tissues of the

body, the arterioles contract and prevent its circulation. The left cavities of the heart, the lungs, and the right cavities of the heart, are in turn and in the above order distended with blood, and ultimately the blood is, as it were, dammed back in the veins, while the arteries are empty, or nearly so.

It is usual, *post mortem*, to find the right cavities of the heart as well as the veins distended with dark blood, while the left cavities of the heart are empty. The explanation offered by physiologists of this fact is that the left cavities, originally distended, are emptied after death by rigor mortis.

The treatment of suspended animation from asphyxia consists—(1) in the removal of the cause; (2) in the stimulation of respiration, and (3) in the stimulation of the circulation. It seems needless to insist that the first measure is to pull the drowning man from the water, or to cut down the man found hanging. These necessary preliminaries having been accomplished, the first thing is to see that *the air-passages are free for the admission of air*. If any articles of clothing are constricting the neck or chest, these should be at once loosened and removed.

Next look to the mouth: pull forward the tongue with one hand, and pass the fingers of the other hand completely into the pharynx, so as to remove any foreign body which may have got there by accident or have been intentionally placed there, such as mud and weeds, a lump of food, false teeth, or possibly some kind of plug intentionally thrust into the pharynx by a determined suicide.

While this is being done the head should be turned to one side, so that fluid may flow out easily. Next, we have to empty the trachea and bronchi of fluid (in cases of drowning), and also to give an opportunity to any fluid which may have been swallowed to be ejected from the stomach. To this end, turn the body on its face, taking care that the trunk is higher than the mouth, and that the mouth is kept open and the tongue pulled well forward; and at the same time exert steady, firm pressure round the margin of the thorax and upper part of the abdomen, so as to assist in the mechanical expulsion of fluid from the lungs and stomach.

This should be done thoroughly and quickly, and the patient should then be turned upon his back, lying on the ground, or better, on a table of convenient height, if one be at hand. The head should be

raised on a small bolster, or a roll of clothing, or anything of suitable size and shape which may be available; the neck should be extended and the chin raised.

Artificial respiration should then be commenced by Silvester's method, which is performed as follows:—

The patient lying as above described, stand directly behind his head, seize the arms at the elbows and press them firmly and gently against the sides of the thorax. By this manoeuvre some of the air in the lungs is expelled, and it is always well to begin with an expiratory movement. Next, pull the arms, gently but firmly, above the head as far as they will go; the removal of the pressure from the elastic thorax and the traction of the humero-thoracic, claviculo-thoracic, and scapulo-thoracic muscles on the ribs cause these latter to be raised and the capacity of the thorax to be increased, and, if the air-passages be free, air *must* flow into the lungs. It is usually easy to tell if the artificial respiration is efficient, for, with or without the aid of a stethoscope, the passage of air through the larynx and trachea can be heard.

It is important to bear in mind that artificial respiration is a purely mechanical act, and that, if efficiently performed, air must enter the lungs, even of a corpse which is hopelessly dead. It is not less important to remember that the efficient entry of air is no sign *per se* of returning vitality. Artificial respiration must not be performed too quickly or too violently. From twelve to sixteen respiratory actions per minute is sufficient. The pressure exerted by the patient's arms and elbows against the sides of the thorax must be firm, and the traction on the ribs effected by the arms, when pulled above the head, must be certain and steady.

Howard proposed another method of performing artificial respiration. The body is first laid prone with the head lower than the trunk, and with a roll of clothing placed beneath the stomach. Firm pressure is then made upon the spine, and in this way fluid is squeezed out of the stomach and lungs. The body is then laid supine, with a roll of clothing in the hollow of the back. An assistant holds the arms drawn above the head, and at the same time keeps the tongue pulled forward. The operator then kneels astride the body, placing the palms of the hands over the short ribs. He then, by alternately throwing the weight of his body on to the palms of his hands and then letting go, produces contraction and enlargement of the thoracic cavity. In this way, air effects an entry and exit from the

lungs, but the method is not so efficient as Silvester's. It is very important to take care not to break the patient's ribs, an accident which has followed excessive and unwise zeal on the part of the operator.

Of all methods of resuscitation, artificial respiration is the most important, and it must not be delayed or relaxed under any consideration. At the same time, it must be remembered that the circulation must be encouraged, and, while the operator is performing artificial respiration, he must give directions to the bystanders to proceed with other measures.

The wet clothing must be removed as best it may, and no hesitation must be thought of in the use of scissors or knife, as an aid to this process. The body must be rubbed dry, and with *warm* towels if possible. Warmth must be encouraged by hot blankets and bottles of hot water to the feet, between the thighs, and to the flanks. Steady friction of the limbs towards the trunk is also of service as an aid to circulation and as a help in restoring the animal heat, of which the patient has, mayhap, been deprived by long immersion.

Stimulants must also be administered. An ounce of brandy, with an equal amount of hot water, should be injected into the bowel, and stimulants should be administered by the mouth if the patient can swallow. The application of ammonia to the nose may be of service, as may also the hypodermic injection of half a drachm of the compound spirit of ammonia.

An electric battery may be of use, and if one is at hand it may be brought. The faradising or induced current must be used, and the object of its use is to cause a vigorous contraction of the diaphragm, and thus aid in respiration. This is not easy to bring about. The best way to proceed is to place one rheophore (well wetted with hot salt and water) on the side of the neck, over the phrenic, in the angle formed by the external border of the sterno-mastoid with the line of the omo-hyoid muscle. Make firm pressure with this rheophore, and when the arms are being raised above the head take the opportunity to place the second rheophore (which should be of large surface and well wetted with hot salt and water) over the sixth interspace in the right axillary line. If, in this way, a vigorous contraction of the diaphragm can be brought about, a far larger volume of air will enter the lungs than when Silvester's method is used alone.

Duchenne advises that in these cases faradisation should be employed for its re-

flex effects, and he recommends that the precordial region and also the back of the chest should be faradised with a wire brush, and he asserts that in this way he has restored circulation and respiration in those apparently dead from suffocation.

If the operator is satisfied that by the methods already recommended air is made to flow into and out of the lungs, well and good; but if he be not satisfied on this head, then, as a last resource, he may have recourse to tracheotomy. Possibly the opening of a jugular vein might allow of the escape of some blood, and thus relieve the over-distension of the right ventricle and encourage it to contract. These two last measures are not recommended as a matter of routine.

From whatever cause the asphyxia may have been produced, the efforts at resuscitation must be continued methodically and thoroughly for at least half an hour, and if the patient be revived, he must be carefully watched for some hours, as it is characteristic of some forms of asphyxia (especially from charcoal fumes) that the sufferer is liable to relapses, and may need the help of artificial respiration a second and even a third time.

In the case of new-born children who have never breathed, the chances of inducing vitality are far greater than in the case of patients whose respiratory functions have been suspended by asphyxia. In the case of the drowned, it is said that recovery is not possible after two minutes' complete immersion; but as the time of immersion can never be certainly ascertained, efforts at resuscitation should not be hastily abandoned.

G. V. POORE.

SUSPENSION.—Mechanical convenience and therapeutic benefit may be derived from the appropriate use of means to suspend the whole body, or parts of it. Having to remove (1862) at the hip-joint a lower limb weighing 99 lbs.—nearly two-thirds of the weight of the whole body—and measuring 48 inches in circumference, the writer suspended the limb. Two long towels passed round the enlargement, and joined in the middle line above, were attached, by a hook and double pulley, to a beam in the roof of the operating theatre. An assistant holding the pulley-rope, while standing well out of the way, was thus enabled to raise and lower the huge limb accurately and easily, greatly facilitating the whole operative procedure, which resulted in the patient's surviving for sixteen years.

Professor Annandale has since advocated, as an aid to surgical demonstrations and practice, the principle of suspension, which has been largely utilised by Professor Sayre in his treatment of spinal disease, by the suspending tripod and the plaster jacket. In arresting hæmorrhage, and treating injured and swollen parts, suspension is of great use and comfort. It is so especially when combined with immobility and equable pressure, by checking the inward and favouring the return blood-flow, relieving pain and promoting absorption and drainage, in direct proportion to its efficiency in lessening vascular and nerve tension. Swellings of the breast, scrotum, and limbs supply many illustrations in point.

Swings, whether with anterior or posterior splints or rods, are very useful; but it is important to bear in mind that suspension in a swing, to be effective, should be elevation and something more. A limb suspended to a bed-cradle by two or three loops of bandage, or leather straps, is certainly raised on an inclined plane, but not swung on the hammock principle. The suspending medium should be as movable as possible, so as to exhaust in its undulations the motive power communicated to the limb. In the case of a limb encased in an accurately fitting mould, and properly swung, undulation of the suspending medium conduces to immobility of the suspended part. In the absence of special instruments, an upper or a lower limb may be suspended, comfortably and efficiently, by very simple contrivances—e.g. fix the limb with a handkerchief, a towel, or a few turns of bandage, on a padded board, or in a wooden or wire frame; then swing this by cords attached to the angles, and gathered into one and suspended by a hook from the bed-head or the ceiling. The effect is harmonious co-operation of apparently very dissimilar mechanical agencies, fixity and mobility in securing perfect rest, preventing irritation, congestion, and their sequelæ, and, in direct measure, favouring physiological repair. *See* IMMOBILITY; POSITION; PRESSURE; REST. SAMPSON GAMGEE.

SUSPENSORY BANDAGES are employed to support the scrotum and testicles in cases of varicocele, hydrocele, epididymitis and orchitis, and to support irreducible scrotal herniæ.

Special bandages, of which there are many varieties, may be obtained for these purposes from instrument-makers, but very efficient ones may be devised by the surgeon with handkerchiefs or a piece of strapping.

The handkerchief should be folded into a band and tied round the pelvis; another should be folded three-corner ways, so as to make a triangular bandage. The middle of the base of the second should then be placed behind the scrotum, and the two ends should be looped over the pelvic girdle from before backwards; the apex of the bandage should be turned up and looped over the pelvic band in front, from behind forwards, and pinned to it. The two ends should be finally brought round and tied in front of the pubes. If the patient be confined to bed, the scrotum may be supported on a band of strapping, which is fixed to the front of the two thighs, so as to form a shelf across the interval between them.

Of the special bandages, the simplest consists of a bag made of silk or cotton netting, suspended from a pelvic band; there is a large opening at the posterior part of the bag, through which the scrotum can be introduced into it, and there is a smaller opening in front for the penis. In some of the suspenders, the size of the bag may be lessened and its base raised, by tightening a running tape placed in the margin of the hole for the penis. In others the bag is buttoned to the front of the pelvic girdle, and can be raised up or lowered, as desired, by fastening it to a higher or lower button on the pelvic band. When the bag is well braced up so as to form an efficient support, the scrotum is pulled forwards and a visible protrusion beneath the trowsers results, and the scrotum is liable to slip out of the bag. To prevent this, two perineal straps may be attached to the posterior margin of the suspender, carried backwards between the legs, and fixed to the pelvic band behind the body.

Keetley's suspensory bandage differs from that above described, in having no aperture for the penis, in the tape round the margin of the suspender being replaced by an india-rubber ring, and in having a median perineal band provided with an india-rubber ring opposite the anus; the ring is intended to prevent chafing of the anus and soiling of the perineal band.

Morgan's suspensory bandage for varicocele consists of a piece of webbing about $4\frac{1}{2}$ inches long, 6 inches broad at one end, and $3\frac{1}{2}$ inches broad at the other; a piece of leaden wire is fixed in the hem at the smaller end, and the long borders are perforated with a series of holes. To apply the apparatus, the piece of webbing should be wrapped round the scrotum and the

affected testicle, the piece of wire being bent so as to form a ring above the testicle; the long borders of the webbing should be laced together so as to envelop the testicle within it. By means of two straps, which are attached to the apparatus, the testicle may be raised up and suspended from a pelvic band; when raised up, the border of the apparatus which contains the leaden ring will be lowest, and upon it the testicle will chiefly rest.

Williams's suspender consists of a triangular piece of netting; one corner of it should be fixed between the legs by a perineal strap, and the base should be raised upwards and fixed to a pelvic band. The effect of this apparatus is to support the genitalia against the lower part of the abdomen.

To support irreducible scrotal herniæ, a strong bag made of jean, and lined with washleather, is used; it may be suspended entirely from the shoulders, or part of the weight may be borne by a pelvic band.

BILTON POLLARD.

SUTURES or stitches are employed to hold the cut surfaces of wounds in accurate apposition during the process of healing. The materials in common use for sutures are silver wire, silver-plated copper wire, soft iron wire, dentist's silk, silkworm-gut, catgut, and horsehair. The metal sutures, silkworm-gut, and horsehair are non-absorbent, and one or other of them should be chosen when means are not taken to prevent putrefaction of the discharges from the wound; an absorbent substance, like silk, would become saturated by the chemical products of putrefaction, and cause irritation, and probably suppuration, along its track. If, however, some form of antiseptic treatment of the wound be adopted, any of the above-mentioned substances may be used for sutures. Silk which has been well soaked for twenty-four hours in a solution of carbolic acid (1 in 20) is as good as any for general use. Catgut has the advantage that, in suitable cases, the deep part of the suture is absorbed and the superficial part is left free in the dressing; carbolic catgut is usually absorbed in four or five days, but the chromicised gut resists absorption for a much longer time. Horsehair makes a very good suture for wounds in which very little strain is thrown upon the stitches.

The soft sutures, such as silk, catgut, or horsehair, may be introduced by any form of needle either straight or curved, but the needle in common use, which is flattened

transversely towards the point, is open to the objection that it makes an incision parallel to the direction of the wound; so that, when the suture is tied, the needle-puncture is drawn into a triangular wound, which does not always heal by first intention. Hagedorn's needle, which is flattened in the opposite direction, makes an incision at right angles to the direction of the wound, and consequently in the line of traction of the suture. For the introduction of wire sutures, some special modification of the eye is needed, so that the loop by which the wire is linked to the needle be not too bulky to be drawn through the needle-puncture. Price's two-eyed needle is one of the best for this purpose, though it is open to the objections above alluded to. *See* NEEDLES.

Sutures may be introduced in many ways: the more important of these will now be considered.

The *interrupted suture* is the simplest. It consists of separate stitches, passed obliquely from without inwards through one side of the wound, and made to emerge in a similar manner from within outwards on the other; each stitch should be tied in a reef knot, and the knot should be drawn to one side of the wound. The sutures should be drawn just sufficiently tightly to bring the edges of the wound into accurate apposition, without constricting the tissues included in the loop. In tying horse-hair or silkworm-gut sutures, the surgeon's knot, in which the first half-knot consists of a double loop, is preferable to the reef knot, because the smooth surface and resiliency of these sutures allows very slight tension to loosen the first half-knot of the reef knot, before it can be fixed by the second.

To close a longitudinal wound, the first suture should be placed in the middle, the second and third on either side of this, between it and the end of the wound, and so on until the wound is sufficiently closed. In angular wounds, or wounds of still more complicated shapes, the retracted angles of skin should be, first of all, fixed in position. Wire sutures may be fastened either by twisting the ends together, or by linking them together as in a half-knot and then turning the ends sharply upwards, so as to prevent the link slipping. The latter method is preferable for stout wires, as the process of twisting them is liable to displace the edges of the wound, which have been previously adjusted.

When a large surface of skin has been removed, as frequently happens in the excision of malignant tumours, the tension of the flaps on the sutures is liable to cause

irritation and inflammation at the margins of the wound, and in that way interfere with their union. In order to obviate this, deep sutures of stout wire or silk may be introduced about an inch from the margin of the wound, and drawn sufficiently tightly to allow of the skin coming together without any strain on the superficial or adjusting sutures. The deep sutures here referred to are often spoken of as *sutures of relaxation*. They should be removed on the second or third day.

In removing sutures, care must be taken that the union of the wound is not disturbed thereby. Silk or other soft sutures should be raised with a pair of forceps and snipped on one side close to the skin, and withdrawn by pulling the knot gently towards the side on which the suture was divided, so that the tendency of the traction is to bring the edges of the wound together rather than otherwise. A wire suture should be divided on one side of the twist or link, and straightened out as much as possible with two pairs of forceps before it is withdrawn.

Continuous Suture.—Under this name two different forms of suture are often included: one is the stitch of the seamstress, in which the thread passes from without inwards through one lip of the wound, and from within outwards through the other; the other is the glover's stitch or the herring-bone stitch, in which the thread passes from within outwards through both lips of the wound. The former is the true continuous suture, and the one usually meant by the term. It is recommended for cases where very accurate apposition of the edges of the wound is desired. It is used, at one time, to be almost the only suture employed for stitching up wounds of the intestines, and it has latterly been recommended for that purpose. It is not a very safe suture, because, if one loop cuts out, the others are liable to become slackened.

The *fold suture*, or suture of Bertrandi, is another form of continuous suture. It is recommended in cases where the skin is very thin, and where, in consequence, the margin is liable to become inverted. It is commenced as an interrupted suture, but, instead of the thread being cut, the needle is passed back again through the lips of the wound, in a similar manner, a little farther on, and so on alternately; so that the loops do not lie across the wound, but alternately on one side and the other, as in the darning stitch of the seamstress. The result of this is that adjacent parts of the deep surface of the skin are brought into apposition, and the tendency to inversion is overcome.

In removing a continuous suture, the surgeon should never attempt to draw the whole thread out together, for in doing that there would be much risk of tearing the wound open, or of tightening up some of the loops, instead of withdrawing the suture; each loop should be divided and removed like an interrupted suture.

The *figure-of-eight* or *twisted* suture is frequently used in plastic operations about the face, and especially in cases of hare-lip. In applying the suture to a wound passing completely through the lip, a long needle should be entered about three quarters of an inch from the margin of the wound and made to emerge on the cut surface close to the mucous membrane, without, however, perforating the latter; it should then be made to perforate the other lip of the wound in a similar manner, though of course in the opposite direction. A piece of silk should then be twisted in figure-of-eight loops round the needle, so as to draw the margins of the wound into apposition without causing much compression of them. If a second needle is required, it should be placed in position before the silk is applied to the first. The points of the needles should be cut off, and a piece of plaster placed beneath the ends so as to protect the skin. The needles should be withdrawn by a gentle rotatory movement in from thirty-six to forty-eight hours, but the pad of silk should not be disturbed until it gets loose. Interrupted sutures should be inserted here and there, to bring the skin and mucous margins into apposition.

The *button suture* is a suture of relaxation, which is very useful when much skin has been removed and a widely gaping wound has to be closed. The buttons are oval pieces of sheet-lead, measuring from three-quarters of an inch to an inch and a half in the long axis, having a small hole in the centre and a wing projecting from each long side of the oval. The free end of a stout piece of silver wire, threaded on a needle, is passed through the hole in the button and secured by twisting it round the projecting wings. In applying the suture, the needle, carrying the wire with the button attached, is entered an inch or more from the cut edge, and brought out at a similar distance from it on the other side. The needle is next passed through the hole in a second button, and the latter is pressed firmly up to the skin until the edges of the wound are brought sufficiently close together; the wire is then twisted round the wings of the second button so as to secure

the suture in position. It is the best suture of relaxation, for the strain is widely distributed by the buttons, and so there is less likelihood of the wire cutting out quickly. Fine interrupted sutures will be required as well, but the greater part of the strain will be borne by the button sutures. Button sutures should, as a rule, be removed by the third day. Their removal is easily managed by cutting the wire between the skin and one button, and pulling gently on the other.

The *quilled suture* is used to bring the deep parts of a wound into apposition, as well as to take off the strain from the superficial sutures. It is most used for plastic operations on the female perineum. For its application, a needle with an eye at one extremity should be threaded with a loop of wire, entered about an inch from the margin of the wound, carried deeply down, and finally made to emerge in a similar manner and at a corresponding point on the other side. The needle must next be withdrawn, and the wire left *in situ*. As many sutures as are required should be passed in the same way. There will then be a loop projecting from each needle-puncture in one lip of the wound, and two strands of wire through each puncture in the other. A quill or piece of bougie should next be passed through each loop, and the quill and loops should then be pulled firmly against the skin. Another quill should be placed on the other side of the wound, parallel with the first, in such a manner that one of the wires of each suture lies over it and the other beneath it, and then the corresponding wires should be twisted together over the second quill with sufficient firmness to bring the lips of the wound into apposition. Superficial adjusting sutures should also be employed.

Various special sutures are employed for *enterorrhaphy*—that is, the closure of wounds of the intestines, or the union of two ends of gut after a resection operation has been practised. They all aim at bringing the serous surfaces of the gut into accurate apposition, for the very rapid adhesion which takes place between them entirely prevents extravasation of the intestinal contents; some aim at bringing the mucous surfaces into apposition as well.

Lembert's suture brings the serous surfaces together without perforating the mucous lining of the gut. The needle is entered on the serous surface, about a quarter of an inch from the margin of the wound, and dipped through the muscular and submucous coats, being made to emerge

on the same side of the wound about one-sixth of an inch from the margin, without perforating the mucous membrane. The needle is next passed in a similar manner through the tissues on the other side of the wound, entering the gut on the serous surface about one-sixth of an inch from the margin, and emerging about one-quarter of an inch from it. As many sutures as are needed are inserted about one line apart, and then they are tightened up, one after the other, and tied in reef knots. It has been urged against this suture that its hold on the intestinal walls is so slight that it is liable to give way, and that, owing to its not perforating the mucous coat, its detachment into the lumen of the gut will be impeded. The latter objection would be met by the use of catgut sutures.

The *Czerny-Lembert suture* differs from the last in the addition of a second row of sutures, which are made to unite the mucous membrane only, just at the cut margins. The advantages claimed for it are that it affords greater security, and also prevents leakage of intestinal contents between the serous surfaces which are adjusted by Lembert's suture.

Gussenbauer's suture is intended to accomplish the same objects as the last with one stitch, which is commenced, like Lembert's, on one side of the wound, but, before it is finished on the other, it is made to pick up the mucous membrane first on one side and then on the other side of the wound, so that, when the suture is tightened up, the deep surfaces of the mucous coat are brought into contact as well as the serous surfaces of the gut.

Jobert's suture. — In the stomach, where the coats are thicker, Lembert's suture may be easily applied, but in the small intestine there is more difficulty on account of the thinness of the muscular coat, and, in order to obtain a more secure hold on the intestinal walls, Jobert recommends that the suture should not avoid the mucous membrane, but should be carried through the whole thickness of the gut. In other respects this resembles Lembert's suture. In cases of complete transverse division of the gut, Jobert recommends the following method of suture: The surgeon first passes a suture, armed with a needle at each end, through the upper extremity of the divided intestine, at about two-thirds of an inch from its margin. The lips of the lower portion of the divided gut are then inverted, so that the serous lining of the reflected portion looks towards the lumen of the gut. This inverted portion is

held in position between the finger and thumb of the left hand, whilst with the right the needles attached to the suture, already inserted in the upper portion, are passed through the double thickness of gut from within outwards; the outer needle is first passed close to the folded border, and the inner one about two-thirds of an inch lower down. A similar suture is passed at the other side of the gut, and then, by pulling at the four ends of the sutures, the upper portion of gut is drawn within the inverted lower portion, so that two serous surfaces are brought into apposition. The two ends of each suture are then tied together. Additional security may be obtained, by inserting a series of Lembert's sutures in the angle where the serous surfaces of the two segments of gut come together.

Gély's suture is recommended by its inventor either for closing linear wounds, or for uniting the gut after complete transverse division. It is a continuous suture. The thread is armed with a needle at each end. One of the needles is entered just behind the wound and about one-sixth of an inch from its margin, and, after traversing the lumen of the gut parallel to the direction of the wound, it is brought out about one-sixth of an inch from its point of entry. A similar stitch is made on the opposite side of the wound with the other needle. The sutures are next crossed over one another and over the wound, and each needle is entered at the puncture from which its fellow has just emerged, and is ready to repeat the stitch. When as many stitches have been introduced as is necessary to unite the wound, the thread is tightened up by pulling on the successive transverse loops, and the ends of the suture on either side of the wound are tied together. This method causes inversion of the edges of the wound, and brings the serous surfaces into accurate apposition.

Emmert's Suture.—The needle is entered on the serous surface of the intestine about one-third of an inch from the margin of the wound, dipped through the serous and muscular coats of the gut transversely to its axis, and brought out about one-sixth of an inch from the margin. The needle is next carried parallel to the direction of the wound, and entered on the serous surface of the gut about one-third of an inch beyond its last puncture, and made to traverse the walls of the gut at right angles to the direction of the wound and emerge about one-third of an inch from its margin. A fellow-stitch should be placed in the other lip of the wound, and as many couples should

follow as are required to close the wound. The corresponding threads on opposite sides of the wound should be tied together, and the serous surfaces inverted and brought into apposition thereby.

Stanmore Bishop has recently described a suture for enterorrhaphy (*Medical Chronicle*, September 1885) which, though it is an interrupted suture, has the advantages of a continuous one; the knots are all within the lumen of the gut, and the loops are so placed that, when loose, they also may readily drop into it. Bishop has found by experiments on animals that, after the employment of this suture, 'no sign of ridge or suture, but a plain mucous surface, with no trace of the previous division,' may result. He uses a small round straight needle, threaded with fine Chinese twist or silk. The needle is placed exactly in the centre of the thread, which, when double, should be about 80 cms. (32 in.) long. 'The edges of the two pieces of divided intestine being approximated, a portion of both is seized by the forceps and turned inwards towards the lumen of the gut, in such a way that the serous surfaces of both are placed opposite and parallel to one another; and near the retiring angle, at the base of the fold thus formed, a needle carrying a double thread is thrust, from the mucous surface of the right side, through what has not retracted of the muscular coat, and through the serous coat of that side, and then through the serous, muscular, and mucous coats of the other side; the double thread is then drawn through until 6 cms. remain on the right side. One of the threads on the left side is to be cut 6 cms. long; the needle is then passed from left to right through the same fold, at a distance of 20 mm. from the first puncture. Two free ends and a loop remain on the left side, and two ends free and two connected with the needle on the right. By gently drawing upon the loop (on the left side), one of each of the two last pairs is seen to move; these are then drawn up so as to bury the loop in the mucous membrane on the left side and are reef-knotted on the right; the two ends are then cut off close to the knot. The free thread left in the first puncture is now drawn under the free extremities of the upper bars of the clamp, so as to be out of the way, and is reserved for the latter part of the operation. The needle is now carried back again from right to left through the base of the fold, and a similar loop is thus formed, this time on the right, and knotted on the left. In this way, as the suture progresses, a series of loops con-

sisting each of a single thread tied alternately on the right and left sides is formed, the threads of each loop passing through the same punctures as those of its neighbours on each side. When half the circumference of the bowel is united, and having finished the floor, so to speak, Mr. Bishop prefers 'to take a fresh needle and thread; and tying one end to one of the free ends of the first thread, which it will be remembered was left behind, to commence again from the mesenteric border, and begin the roof from that point.' Thus the operator works towards himself whilst stitching both the floor and roof. 'In drawing up the loop which is thus formed, care must be taken to bring the knot in its centre directly opposite the middle of the portion of wall included.'

'On finishing the floor, too, a free thread will always be left; this is taken advantage of in finishing the entire suture, for the last loop is made by tying the two free ends on one side together; the loop thus formed is then drawn up on the other side, folding in the serous coats of both sides, and, the knot being made, the two threads are cut off close, the bowel becoming absolutely closed.'

BILTON POLLARD.

SWEATING FEET.—This offensive affection is not uncommon in young persons of both sexes, especially in those employed in in-door service, the subjects of it being often incapacitated from retaining their situations. The general health is usually not good, the circulation feeble, and the appetite often disordered.

Treatment.—The feet should be well bathed in salt and water two or three times a day, rubbed and dried most thoroughly, especially between the toes, and these parts well dusted with zinc and starch powder, to which a little iodoform powder has been added. Boots or shoes, socks or stockings, should be changed frequently; anything in the nature of patent leather is to be forbidden, and shoes preferred to boots, as admitting of better ventilation and more frequent changing. Belladonna liniment, as recommended by Dr. Ringer (the liniment being made up with eau de cologne, if preferred), may be employed; or the treatment recommended by Professor Hebra made use of. Here, an ointment made of equal parts of lead ointment and linseed oil, spread on linen, is wrapped round the feet, the application being renewed every third day for nine days. The practitioner, in using the above, must be prepared for its causing irritation in some cases, and even the outbreak of a papular eruption.

Improvement of the general health is nearly always required, it being needful to insist on sufficient open-air exercise, bathing, and attention to the appetite and bowels. See BROMIDROSIS.

W. H. A. JACOBSON.

SYCOSIS.—*Synon.* Sycosis non-parasitica, Mentagra.

Definition.—A chronic inflammatory disease affecting the hairy parts of the body (chiefly the face in the male sex), and characterised by the development of pustules pierced by hairs.

Cause.—This has not yet been ascertained; various diathetic conditions were formerly thought to give rise to it, e.g. rheumatism, gout, struma. According to later investigations, it is probably due to the irritation of the growing stiff hair on the walls of the follicle, in an individual out of health, or on a part predisposed to inflammation by the presence of some superficial dermatitis (eczema). Shaving, especially with irritating soap, and exposure to heat or cold, are also thought to be instrumental in causing the disease.

Pathology.—The affection is primarily a peri-folliculitis, the fibrous sheath of the hair-follicle being first invaded by inflammatory products (serum and pus). Soon the root-sheaths become involved, and the base of the follicle, the papilla resisting to the last; the hair-coverings (root-sheaths) as well as the soft structure of the hair itself, undergo destructive change, the hair falls out and is not reproduced if the papilla has been destroyed; not infrequently the neighbouring structures, the sebaceous and sweat glands, and even some portion of the skin itself, are involved in the destructive process, leading to loss of substance and scarring.

Symptoms.—In a simple uncomplicated case, at the commencement of the disease, there are seen a few papules pierced by hairs, accompanied by some temporary heat and swelling of the part affected, usually the chin. The papules may be isolated, but they tend rather to be aggregated together in groups. Soon each papule becomes surmounted by a minute collection of pus, the papule becomes converted into a pustule, if the lesions are close together the infiltrations surrounding each join up and become confluent, so that the affected patch takes the form of one large dusky-red infiltration dotted over with points of pus, pierced by hairs; it was probably this appearance which was likened to the inside of a fig and suggested

the name Sycosis (*συκων*, a fig). The pustules may dry up into little round crusts, or, as happens more frequently, they discharge and lead to the formation of thick yellowish-brown crusts of dried inspissated pus. The hairs over the affected surface are either matted down, or stick up through the crusts. On removing the latter, those hairs which are loose in their follicles come away; a few remain behind in the dilated funnel-shaped mouths of the follicles. Occasionally, on removing the crusts from an infiltrated patch, the surface is seen beneath denuded of epidermis, granular, and bathed with pus (*caro luxurians*) calling to mind the appearances of condyloma. More deeply seated and extensive suppuration may occur, leading to the formation of small subcutaneous abscesses. The disease progresses by separate outbreaks such as has been described. Chronic cases are liable to be complicated by (a) the occurrence of a permanent, diffuse, erythematous-squamous, superficial dermatitis, affecting perhaps the entire beard or whisker region, the result of previous attacks; or by (b) more or less scarring and alopecia from former destructive suppuration.

Diagnosis.—This lies between sycosis parasitica, eczema impetiginodes, lupus, and syphilis.

Sycosis parasitica.—The early, red, itchy patches frequently round and multiple (*tinea circinata*), the continuous outbreak of pustules, the gnawed stubbly look of the hairs, their opaque white appearance and rottenness, the history of contagion and rapid development of the disease—finally, the presence of fungus as seen under the microscope, are the points determining the diagnosis.

In eczema the eruption is not limited to the hairy parts, but it must be remembered that eczema may be present with sycosis, having either preceded it, in which case it may be looked upon as having caused the sycosis, or it may have supervened, as explained above.

In eczema impetiginodes, its rapid development, appearance elsewhere, the abundant discharge, the large flat pustules *not* pierced by hairs, the non-occurrence of alopecia or scarring, will help the diagnosis.

Lupus vulgaris generally occurs before puberty, and is very chronic, the tubercles are not pierced by hairs, the nose or its neighbourhood has probably been previously attacked; loss of substance and scarring invariably accompany lupus.

In syphilis the papules or tubercles (copper-coloured), tend to be arranged in rings or segments of circles, they are painless and not pierced by hairs; concomitant symptoms are usually present—scars, gummata, &c.

Treatment.—This is mainly local. The hair should be cut short with scissors to within one-third of an inch of the affected surface. All crusts must be removed before any remedies are applied. This may be done by saturating them with warm oil or some simple ointment, then poulticing with linseed meal; if they are still matted down by the hair, they should be slightly raised and the hairs snipped beneath them, the part should then be bathed clean with warm water.

As long as irritation is present (heat, swelling, &c.) only soothing applications should be used, e.g. :—

R Pulv. zinci oxidi. . . . ʒvj.

Liq. plumbi diacet. dil. . fʒvj.
ft. lot.

or Linimentum calcis. These remedies should be frequently and thoroughly applied to the affected parts.

Pus must be removed as soon as possible; small abscesses should be opened, and, above all, the hairs must be pulled out from the pustules. Each hair is to be grasped with epilation-forceps, and steady traction made in the direction in which it is growing; the hairs protruding from pustules will generally be found loose in their follicles, coming away without pain. By this procedure the pus is provided with an outlet, and the best chance afforded of avoiding destruction of the papilla. Some desiccant, soothing ointment should now be used night and morning, applied on linen and bound to the part. Hebra's ung. diachyli, ung. zinci benzoati, or ung. plumbi carb., are suitable ointments. If there is much infiltration the occasional use, once in two or three days, of some mercurial preparation will be necessary, such, for instance, as hydrarg. oleat. 5 p.c., or ung. hyd. ammon., mitigated by the addition of an equal quantity of ung. zinci. Opinions are divided as to the advisability of shaving the part; but the disease may be cured without resorting to this painful procedure of doubtful benefit. The patient should abstain from anything which may promote the disease—exposure to dust, heat, &c. Finally, constitutional treatment must not be neglected. The diet should be enquired into and regulated as to the quantity and quality of both food and drink. Dyspepsia, if present, must be treated, as well as any diathetic condition

(especially struma), on general principles. It is probable that nearly all cases will benefit by judicious regular purgation.

SYCOSIS PARASITICA.—Synon.: *Tinea barbæ*, ringworm of the beard.—An inflammation of the hairy parts of the face and neck, set up by the presence of the fungus of ringworm (*trichophyton tonsurans*).

Symptoms.—The disease generally shows itself at first as a small, sharply defined, round red patch, not raised above the surface. Not infrequently several such patches are present—the eruption soon becomes marginate, or exhibits signs of papulation and desquamation. Considerable infiltration with suppuration may early disclose itself, or indeed be present from the commencement, so that the disease puts on a scattered, pustular appearance, the surface being studded with crusted elevations pierced with stumps of hairs. Itching is complained of. The disease advances steadily, not by successive outbreaks. Changes in the hairs of the part affected are soon noticeable; if the beard or whisker is grown, there is partial baldness, the hairs have a gnawed, stubbly look, some are reduced to mere stumps, and have a peculiar, opaque, whitish appearance, like the stumps seen in *tinea tonsurans*. By pulling them slightly with the epilation-forceps, they break off close to the mouth of the follicle. On placing such stumps, or any other affected hairs, on a slide with a little liquor potassæ, and examining under the microscope with a high power ($\frac{1}{4}$ inch), the hairs are seen to be infiltrated with fungus-spores arranged together in chains, for the most part lying in the direction of the hair-fibres. These hair changes are of course most noticeable in cases where the beard or whisker is worn, but even when the patient has shaved, the white stumps may be recognised with a magnifying glass, just protruding from the follicles; they may be collected by scraping with a knife which has been dipped in liquor potassæ, and submitted to microscopical examination.

Diagnosis.—The disease may be confounded with—1. True sycosis (*sycosis non-parasitica*); 2. Eczema; 3. Syphilis. In all doubtful cases the microscope should be appealed to; if the fungus is found, it at once settles the question. The following peculiarities belong to *tinea*.

1. Early round or ringed patches; 2. Continuous and comparatively rapid development; 3. Absence of scarring or other signs of previous attack; 4. History of contagion (barber's razors, &c.); 5. Probable

existence of patches of ringworm on other parts of the body; 6. Partial baldness with stubbly appearance of hair, whitish brittle stumps, &c.

Treatment.—All pus-crusts must be removed, and if much irritation is present, this must be allayed before antiparasitic remedies are used (*see Sycosis non-parasitica, treatment*). The antiparasitic measures include all those which are adopted for the treatment of ringworm of the scalp. Of all the mercurial and tar preparations, perhaps the best are oleate of mercury and carbolic acid; the former should be used of the strength 5 p.c., at least at first; it should be freely rubbed in once every twenty-four hours, or more frequently if the skin can tolerate it. Should much irritation occur, the remedy should be discontinued for a day or two until the part recovers itself.

The glycerine of carbolic acid may be used in a similar way. The pharmacopœial Ung. hyd. nit., or Ung. sulph., are also useful remedies. Such applications necessarily set up a certain amount of inflammation, but they are especially liable to do so in cases where the disease has displayed a marked inflammatory type from the commencement. Success depends on the persistent use of efficient parasitocides, short of producing unmanageable inflammation. Epilation should be adopted, but it cannot be relied on to cure the disease.

ALFRED SANGSTER.

SYMBLEPHARON. *See* EYELIDS, Diseases of the.

SYME'S AMPUTATION OF THE FOOT. *See* ANKLE-JOINT, Amputation at the.

SYME'S OPERATION. *See* TONGUE, Operations for Removal of the.

SYMPATHETIC OPHTHALMITIS is a plastic inflammation of one eye, excited by some special irritation in the other. There are two forms of this disease: the first form, being the slighter, is called Sympathetic Irritation; the second is the severe affection now so well known as Sympathetic Ophthalmia.

1. **SYMPATHETIC IRRITATION** is probably only the early stage of sympathetic ophthalmia, as it will develop into it and is excited by the same causes. Sympathetic irritation is secondary to some excitant in the other eye, which is usually of an inflammatory character. The attacks are difficult to arrest, and they are very recurrent so long as the excitant in the other eye continues.

The points in which sympathetic irritation differs from sympathetic ophthalmia are:—1. Although the eye may be liable to frequent recurrences of the irritation, yet no fibrinous effusions nor disorganising changes take place in the tissues of the eye. 2. The excision of the injured or the diseased eye will, as a rule, at once arrest the irritation; whereas, in sympathetic ophthalmia, the excision of the other eye will but rarely exert any marked influence in controlling the disease.

The symptoms of sympathetic irritation are attacks of irritability of the sound eye, whenever the lost or injured eye becomes inflamed or painful; and, in some cases, whenever the sound eye attempts any prolonged effort of accommodation, without any change of appearance or altered sensation in the injured eye, and this is especially noticeable in eyes in which a foreign body is lodged. The symptoms are very variable: in some patients a slight indistinctness of vision is complained of, an inability to define clearly, and reading tires the eye. The patient may be able to read No. 1 of Jaeger's test types and to see distant objects rightly, but he cannot do so for any length of time, as the effort of accommodation fails, and the eye becomes fagged. In others, the eye becomes reddened and irritable whenever an attempt is made to use it, and occasionally it is painful; the seat of pain being sometimes referred to a position in the sound eye corresponding to the seat of injury in the other eye. Occasionally, there are neuralgic shooting pains in the sound eye, and this may be the symptom which gives the patient the greatest concern. Another symptom of which patients have frequently complained is that 'things dazzle in front of the sound eye, like heat over a stove.' There is frequently also some slight intolerance of light; the patient feels that the bright light of a clear day or bright artificial light is unpleasant. The symptoms of irritation are not always constant. In some cases there are attacks of irritation, which come on only when the lost or injured eye becomes inflamed, and subside when the inflammation has passed away; whilst in others the sense of there being something wrong with the sound eye, from the occurrence of some of the symptoms described, is ever present.

The treatment of sympathetic irritation undoubtedly is to excise the lost or injured eye, the source of the irritation, as with our present knowledge we cannot say when sympathetic irritation will drift into

sympathetic ophthalmia. If the injured or diseased eye be excised when there are symptoms only of irritation, and before the spotty deposits on the inner surface of the cornea have been developed, then we generally succeed in arresting the disease. The writer has known cases in which the attacks of irritation have continued to recur, at short intervals, for over twelve months, and yet, after the diseased or injured eye has been removed, the irritation has been completely arrested.

The palliative treatment consists in giving rest to the eyes by abstaining from work, by excluding the eyes from strong light by means of dark glasses, and by keeping the light in the living room subdued by dark blinds. As a local application, a weak solution of atropine, about gr. j. to the ounce of water, and internally small doses of the extract of belladonna, from gr. $\frac{1}{10}$ to gr. $\frac{1}{2}$ combined with quinine, are the most useful medicine.

2. SYMPATHETIC OPHTHALMIA differs from all other inflammations of the eye, both in the cause which produces it and in the character and course of the inflammation.

a. It is always due to some exciting cause in the other eye, and these may be thus briefly classed:—

Wounds of the eye, and especially those which involve the ciliary region; and wounds in and near the margin of the cornea, in which there is an entanglement of iris.

The lodgment of foreign bodies within the globe.

The irritation excited by degenerative changes taking place in eyes already lost either by injury or disease.

There are other causes which also give rise to sympathetic ophthalmia, but which may be regarded as exceptional. The operation for the extraction of cataract undoubtedly produces a certain percentage of sympathetic ophthalmia, but these unfortunate cases are, probably, far less numerous now than they were ten or fifteen years ago. About that date, it was the custom with many to carry the section through the sclerotic a little behind the corneo-sclerotic junction, and as the result to get frequently an entanglement of the iris in the edges of the wound. Experience has since proved that, by keeping the section corneal, we have less tendency to involvement of iris in the wound, and consequently many fewer cases of sympathetic ophthalmia following our cataract operations.

In the *Royal London Ophthalmic Hospital Reports*, vol. vi., Mr. Hulke has

recorded the case of a cyst of the iris which followed a penetrating wound with a fork. There was a serous iritis in the eye which had the cyst, and in the other there was sympathetic irritation. It was on account of the irritation in the uninjured eye that the mother brought the boy from Faversham to the hospital. Mr. Hulke removed the cyst through an opening at the margin of the cornea. The report states: 'The wound healed directly, and the iritis and sympathetic irritation of the other eye disappeared.'

It is a noteworthy fact that sympathetic ophthalmia is seldom, if ever, produced by a suppurative inflammation of the other eye. This fact was noticed by the late Von Graefe, and the writer's experience accords with it. If, however, there is a foreign body within the globe, suppuration of the eye does not diminish the danger which its presence in the stump may keep up.

β. *The character of sympathetic inflammation of the eye* is peculiar. It is essentially an adhesive or fibrinous inflammation. The tendency of the inflammation is to rapid, plastic effusions, which soon become organised and incapable of absorption, blending the tissues together and destroying their functions. As a rule, the eye is attacked without having pain as a warning. Children are frequently brought with the disease advanced into its second stage, and with the sight greatly impaired, because the absence of pain made the parents regard the affection lightly.

When once started, sympathetic ophthalmia is very difficult to arrest, and if, under treatment, it is subdued, it is generally only for a time, for the disease is very recurrent. The peculiar tendency of sympathetic inflammation to cause rapid effusion of lymph is manifested from the very commencement of the disease. In the earliest stage, there are usually spotty deposits of lymph on the inner surface of the cornea; then follows a plastic inflammation of the iris, which binds the pupil by adhesions to the anterior capsule of the lens, and rapidly extends to the ciliary processes, the choroid, and the vitreous. The lymph is not deposited on the surface in nodules, as in syphilitic iritis, but it occurs as an infiltration invading the very texture of the iris, ciliary processes, and choroid. In the synechiæ which are formed, it is not simply the pupillary margin, but the whole posterior surface of the iris which contracts adhesions to the capsule of the lens; so that if, at a future period, an attempt be made to form an artificial pupil by tearing

away a portion of the iris, the exposed part of the lens will be found covered with uvea, indicating exactly the extent of the adhesions which had existed between it and the posterior surface of the iris. Early in the disease, when the iris is saturated with lymph, it is soft and rotten; but at a later date, when all the acute symptoms have passed away, the iris has become completely changed in its texture; it is excessively tough, it has lost all its elasticity, and is converted into a dense fibrous membrane. *The age of the patient* has an influence in sympathetic ophthalmia. The young are more liable to it than the old, and it runs its course more rapidly in the child or young adult than it does in the middle-aged or the old.

The Period at which Sympathetic Ophthalmia may come on after Injury.—It is impossible to assign any date at which sympathetic ophthalmia may be expected, or after which the sound eye may be considered as safe. It is seldom seen earlier than two or three weeks after the injury, and generally much later. So long as the irritation primarily excited by the injury continues, the sound eye may sympathise. The risk cannot be said to have passed away until the injured eye has quite recovered; the sclerotic must have regained its normal whiteness and all photophobia and lachrymation have ceased. It is the knowledge of these facts that has often induced the writer to urge upon a patient to have the injured eye removed, when it has drifted into a state of subacute irritability with no tendency to yield to remedies, and when there was no reasonable prospect of the eye regaining useful sight. In such cases, it is better to make a partial sacrifice for the sake of securing the safety of the uninjured eye.

Symptoms.—For the convenience of description, the symptoms of sympathetic ophthalmia may be divided into three stages, a division which, although arbitrary, serves to impress the progress of the disease upon the memory of the surgeon. It must, however, be remembered that, in many cases, the symptoms succeed so rapidly on each other that it is difficult to recognise the division into stages. In some cases, the disease has passed well into the second stage before it is even recognised that the uninjured eye is affected; and this is especially the case in children, from the absence of pain in the early stage of the affection.

In the *first* stage of the attack, the eye is irritable and abnormally sensitive to

light; there is some lacrymation, and the conjunctiva is a little injected; there are usually spotty deposits of lymph on the inner surface of the cornea (*corneitis punctata*), sometimes only to be detected by looking at the cornea with a lens, and the pupil is sluggish in its action; the power of focussing the eye for near objects is diminished, and the patient is unable to maintain a prolonged accommodative effort. Reading quickly induces fatigue, the words become confused, blurred, and at last indistinguishable; after a few minutes' rest the eye may resume its work, but the same symptoms shortly reappear and oblige it to desist. At this stage of the disease there is generally *no pain*—not even sufficient to draw proper attention to the eye.

In the *second* stage of the disease, fibrous exudations take place within the eye, and lymph is effused, as an infiltration, into the different tissues involved in the inflammation; the pupillary area of the capsule of the lens is covered, and the iris almost soaked with it. This exudation rapidly becomes organised, and contracts firm adhesions between the whole posterior surface of the iris and the lens-capsule. If atropine be dropped into the eye, the pupil is either not affected by it or it dilates only slowly, irregularly, and partially. The aqueous becomes serous, and the striation of the iris, at first indistinct, is afterwards completely lost.

The *third* stage of the disease is characterised by increased tension of the globe, and this condition is *generally associated with pain*, oftentimes very severe, and sufficient to make the patient willing to submit to any means suggested for his relief. The increase of tension may come on at any time after the inflammatory exudations within the eye have commenced, and may continue during many months, or even last beyond a year. If the disease runs on, the vitreous atrophies, loses its consistence and diminishes in bulk, and the eye gradually becomes softer than normal and sinks to -T 2 or 3. As the atrophy of the vitreous proceeds, the retina is deprived of its normal support, and, falling forwards, becomes partly or completely detached.

The increased tension of the eye, combined with the inflammatory changes in the ciliary region, sometimes leads to a thinning of the sclerotic around the cornea, and to ciliary staphyloma.

Treatment.—Sympathetic ophthalmia is certainly one of the most intractable of all the affections of the eye. Many cases go on from bad to worse until the eye

is lost, and this in spite of what appears to have been judicious and careful treatment from the very commencement of the disease. Still, we occasionally meet with bright results, although these are comparatively few.

The *treatment* will be considered under three headings:—1. How to arrest the progress of the disease. 2. How to proceed when the injured eye still retains some useful sight. 3. The general constitutional and local treatment in each of the three stages of the affection.

1. *How to Arrest the Progress of the Disease.*—If the sympathetic inflammation of one eye is dependent on injury to the other, and it is clear that the wounded eye is irreparably blind; or if the exciting cause of the mischief proceeds from a previously lost eye becoming inflamed, then there cannot be a moment's hesitation about the propriety of at once extirpating the injured or the diseased eye. The importance of removing at an early period an eye which has been so injured as to be useless, and which is exciting, or is likely to excite, irritation in the other, or the inflamed remnant of a lost eye which is acting as an irritant, cannot be exaggerated. For, though, in the *very early stage* of sympathetic ophthalmia, the removal of the cause of irritation will frequently cause its subsidence, yet, when the disease has thoroughly taken hold of the sound eye, even the removal of the lost one will rarely arrest its progress. The writer's experience leads him to believe that if an injured eye be excised before symptoms of irritation occur in the other eye, then the sound eye is safe from sympathetic ophthalmia. There may be exceptions to this rule, but they are probably very few.

Division of the optic nerve has been suggested to take the place of excision of the injured eye. Experience, however, has shown that optic neurotomy of the injured eye does not succeed in warding off sympathetic ophthalmia. Pagenstecher published a case in Knapp's *Archiv f. Ophthal.* viii., where the optic nerve had been torn off, and yet sympathetic ophthalmia occurred in the other eye. Cases of sympathetic ophthalmia have also come on in the other eye after the optic nerve in the injured one had been divided. We may therefore consider that the division of the optic nerve of the injured eye fails to arrest the disease. From the experience we possess of the power nerves possess of reuniting, it is difficult to understand how the division of the optic nerve could arrest the develop-

ment of sympathetic ophthalmia, as, supposing that the transmission of the *materies morbi* is through the lymphatic spaces of the optic nerve, these spaces would have again become continuous after union of the nerve had been effected.

2. *How to proceed if the Injured Eye still retains some Sight.*—On several occasions the sound eye has been destroyed by sympathetic ophthalmia, while the injured eye has ultimately so recovered that useful sight has been restored to it, and the patient has been able to get about without assistance. As the removal of the injured eye will probably not arrest the sympathetic ophthalmia, and especially if plastic exudations have commenced, the conclusion at which the writer has arrived is, that if sympathetic ophthalmia be established, the injured eye should not be removed if it retains any useful sight.

3. *General Constitutional and Local Treatment.*—In the early stage of the disease, absolute rest to the eyes is imperatively demanded; all reading, writing, or fine work of any kind must be forbidden. When at home, the rooms should be darkened, and when out, very dark neutral-tinted glass goggles should be worn. It is impossible to overrate the importance of keeping the patient for a long period in a very subdued light; it affords the best hope of success, and places the eyes in a position to receive most favourably the influence of any other treatment which may be adopted. However well the patient may progress, the order to rest the eyes and abstain from work should not be rescinded for at least from six to eight months. The disease is very recurrent in its nature, and the too early exposure of the eyes to the stimulus of strong light will increase the chances of relapse.

During this stage, mercurial inunction into the temple with unguent. hydrarg. or the hydrarg. oleat. five per cent. cum morphia, may be tried and continued for two or three months, care being taken to avoid salivation by diminishing or omitting the rubbing in for a few days, as required. The patient should be well fed, as the disease is very depressing, and quinine in 1- or 2-grain doses, according to the age of the patient, combined with small doses of the extract of belladonna, or bark with the succus belladonnæ, may be given. From the use of iodide of potassium and perchloride of mercury—both of them favourite medicines in the treatment of irido-choroiditis—the writer has never known the slightest benefit.

Local Applications.—A weak solution of atropine, gr. j. to the ounce of distilled water, may be dropped into the eye three or four times a day; or a belladonna lotion may be frequently used. In the later stages of the disease, when the whole posterior surface of the iris is adherent to the capsule of the lens, all mydriatics do harm by stimulating the dilating fibres of the iris to contract when, from the adhesion of the iris to the lens-capsule, they cannot act. Mydriatics also favour the development of the state of increased tension which usually comes on at a later period of the disease.

In the *second stage* of the disease, when the union between the iris and lens-capsule has been effected, but after the acute symptoms have subsided and the eye is quiet, it is a question whether an operation may be attempted to improve the sight. The writer's opinion is, that if the sight is sufficient for immediate requirements, and will enable the patient to walk about without assistance, the eye should be left alone. It is the only eye; and operations on eyes sympathetically inflamed are so unfavourable, that it is better to let the patient enjoy the sight he has rather than to risk the loss of it with the prospect only of a slight improvement. If, however, the sight is so defective as to be almost useless, and there is a fair field of vision, then an attempt should be made to improve it by an operation; but no operation should be performed whilst the eye is inflamed. The objects to be attained are the formation of a new pupil and the extraction of the lens. There are very few eyes which have suffered from sympathetic ophthalmia, in which an artificial pupil can be satisfactorily made without, at the same time, removing the lens. The iris has become so changed in structure, and so adherent to the lens-capsule, that it is difficult and often impossible to perform an iridectomy; and even when this can be accomplished, it usually fails to benefit the sight from the exposed capsule of the lens being coated with adherent uvea. It is, therefore, generally advisable to endeavour to remove a portion of the iris and to extract the lens in the one operation. First, make a section of the cornea with a fine Graefe's cataract-knife; then, if possible, remove a portion of iris; but, failing to accomplish this, tear open the pupil and through the capsule of the lens with a cystotome; or, if this be insufficient, remove a portion of the iris and the adherent lens-capsule with a pair of iris-scissors; and, lastly, with a little pressure on the globe with the back of the

curette, cause the escape of the lens through the corneal wound. This operation may generally be accomplished without the loss of any vitreous, and the eye will usually recover from its effects well; but the pupil will probably again become closed. Another operation will afterwards be required for the formation of a new pupil. The extraction of the lens seems to exert a beneficial influence on the eye, as, after it has recovered from the effects of the operation, it is much less disposed than it was before to a recurrence of the inflammation.

In the *third stage* of the disease, when there is an increased tension of the eye, active treatment is necessary. If the state of tension be long continued, the little sight that is left soon vanishes, and relief also is required for the pain which so frequently accompanies the tension. An attempt to do an iridectomy the writer has always found unsuccessful. In these cases sclerotomy is a useful operation. A narrow Graefe's cataract-knife is to be made to pierce the sclerotic just external to the corneo-sclerotic junction, and to be directed across the front of the iris to a corresponding point on the opposite side. After slight cutting, so as to make the section a little broader than the breadth of the blade, the knife is to be withdrawn, leaving a wide bridge between the sections. Sclerotomy may be performed, in sympathetic ophthalmia, where there has been great pain associated with increased tension, and in cases where there have been pain, tension, and ciliary staphyloma, and with very good results.

Of the *pathology* of sympathetic ophthalmia we know but little. There is, however, one remarkable fact with reference to its exciting cause, which is, the important part the iris, or some part of its continuation, the ciliary processes or choroid, plays in originating the disease in the other eye. Looking over all the causes which induce sympathetic ophthalmia, we find that either the iris, ciliary processes, or choroid are invariably involved. In injuries of the eye, it is the wounds in the ciliary region; in corneal wounds, it is the entanglement of iris; after cataract or other operations, it is the prolapse of the iris which gives rise to sympathetic ophthalmia.

In the lodgment of foreign bodies within the eye, the danger is when the foreign body is embedded in the iris or the ciliary processes, or when it has gone still deeper and is buried in the choroid, or from lying on the retina it presses on the choroid. Sympathetic ophthalmia may arise from a chip

of metal which has penetrated the cornea without wounding the iris, and lodged itself in the lens. So long as it remains in the lens the other eye is safe; the danger is that, with the absorption of the lenticular matter, it may become detached from the lens, and fall to the deeper parts of the eye. Again, a fragment of a gun-cap has been seen in the vitreous, and there it remained for a long period without producing any irritation; the danger was that it might become detached from its bed in the vitreous, and then produce irritation in the other eye.

Detachments of the retina, even from violence, fail to produce sympathetic ophthalmia. There may be hæmorrhage from the choroid detaching a large portion of the retina—accidents which are of frequent occurrence; and yet no sympathetic ophthalmia. The extensive detachments of the retina from other causes, which lead to blindness of the eye, do not produce sympathetic ophthalmia; in such cases, it is the degenerative changes in the choroid which take place at a long period after the detachment of the retina, which cause the other eye to suffer. So, also, in eyes which have been long lost from any cause, it is the degenerative changes in the choroid which excite sympathetic irritation and ophthalmia in the sound eye. In cases of displacement of the lens from blows on the eye, no matter whether the dislocation be partial or complete, the danger lies in the pressure which the displaced or swinging lens exercises on either the iris, ciliary processes, or choroid.

It is very difficult to say through what channels the inflammation of the injured eye is transmitted to the sound one—whether the sympathetic ophthalmia is due to reflected nerve-action, or whether the inflammation is propagated by simple extension along some special track. The pathology of the disease is still under investigation, and, until we know more of it, it is useless to harass the mind of the surgeon with mere hypotheses.

GEORGE LAWSON.

SYMPHYSIOTOMY (SIGAULT'S OPERATION).—This operation was originally proposed by a Parisian medical student named Jean René Sigault, in 1769, and was first performed by him in 1777, with a successful result.

The pubic symphysis is divided in cases in which contraction of the pelvis prevents natural delivery; the pubic bones are thus allowed to separate, the sacro-iliac synchond-

droses acting as hinges. The child is then born by the natural process.

The early operations were chiefly performed in France, with some few in Germany, Belgium, Holland, and Spain, and one only in England, which terminated fatally to both mother and child. The operation then found favour in Italy, and was extensively performed in Naples, but died out in 1858.

Dr. Harris, of Philadelphia, U.S., has tabulated 70 cases, with the loss of 26 mothers and 47 children. In 1866 it was revived in Naples, and from that time to the end of 1880, 50 cases were operated upon; 40 mothers recovered and 41 children.

The operation being chiefly in the interest of the child, the large infantile mortality told against its adoption. As regards the maternal mortality, however, it compares very favourably with the results of Cæsarean section; and if the complete results of embryulcia could be collected, symphysiotomy would probably hold its own in comparison with these operations.

Operation.—In Naples the symphysis is divided subcutaneously with a probe-pointed and sickle-shaped knife. An opening is first made in the skin above the pubic arch, then the knife is passed carefully behind it, and the section is made by cutting from below upwards. With careful antiseptic precautions this should not be a dangerous procedure. In about one case in four the forceps are applied to aid the birth of the child. The pubic bones are fixed by an immovable apparatus as soon as possible after the operation. Asymmetry of the pelvis may make it difficult to exactly hit the cartilage in performing the section, and a corner of one bone may be sliced off; but this would be of no consequence in a thoroughly aseptic case.

Metropéritonitis was the cause of death in the majority of the fatal cases in the recent Neapolitan revival; and though only one of these is specified as septic, it is probable that sepsis was the chief agent in the production of the fatal inflammation.

J. KNOWSLEY THORNTON.

SYNOVIAL MEMBRANE, Pulpary Degeneration of.—This term is applied to a condition of the synovial membrane resulting from chronic inflammation, in which the delicate membrane of health is replaced by a thick, semi-opaque, gelatinous mass of tissue, of low organisation and degenerative tendency.

This growth usually affects uniformly the whole synovial membrane of the joint;

it may attain the thickness of a quarter or half an inch; it is of a dull yellow colour, varied here and there with spots and streaks of whiter hue, and the red lines of a few small blood-vessels; its consistency varies from a gelatinous softness to a considerable degree of toughness. In advanced cases numerous points of fatty softening and of suppuration are seen; and its free surface may be covered with a layer of pus-secreting granulation-tissue. It adheres to the cartilages, and bulges into all the less resistant parts of the joint.

Sections of this material exhibit, under the microscope, a delicate fibrillated stroma, containing in its meshes free nuclei and nucleated cells of varying size and shape, but mostly of somewhat oval outline.

These changes in the synovial membrane are accompanied by symptoms of chronic joint-disease. At first, there is but slight swelling and heat, with a little tenderness, often of limited area; but, as the disease progresses and the synovial membrane becomes more thickened and pulpy, the bony outlines of the joint are concealed by a general elastic swelling, giving to the touch a deceptive sense of fluctuation. The ligaments soften, the cartilages ulcerate, the bone-surfaces become displaced, and the functions of the joint are slowly but surely lost. Eventually, suppuration usually occurs in some part of the thickened tissue, and matter makes its way either to the surface or the interior of the joint.

The *treatment* of this disease consists in long-continued rest and counter-irritation, together with such constitutional measures as tend to improve the general nutrition of the patient. But, in its advanced stages, the changes are irremediable, and the best that can be hoped for is a permanently crippled joint. The alternatives, therefore, are—(1) To apply a splint, restrict movement, and avoid the use of the joint, leaving it lamed but painless and quiescent; (2) to open the joint and remove the diseased tissue by scraping or solution; (3) excision, whereby the articular surfaces, together with the altered synovial membrane, are removed, and an ankylosed limb or a false joint results. See JOINTS, Diseases of.

J. WARRINGTON HAWARD.

SYNOVITIS.—**ACUTE SYNOVITIS.**—The synovial membrane is, of all the joint-structures, the most commonly inflamed. It is exceedingly sensitive to injury and to the presence of any septic material, whether introduced by a wound or circulating in the blood. Thus, the majority of cases of acute

synovitis are of traumatic, septic, or rheumatic origin; and most acute joint-diseases commence as inflammation of the synovial membrane.

The *symptoms* of acute synovitis are pain, heat, and swelling of the affected joint, in addition to which there is pyrexia, of a degree proportionate to the size of the joint and the activity of the process. The pain is increased by movement; if the joint be superficial, its increased temperature can be easily felt by the hand; the swelling is limited by the synovial reflexions, it is elastic and fluctuant, and conceals the outlines of the articular ends of the bones.

If a joint be examined in the early stages of acute synovitis, the membrane is seen to be swollen and of bright red colour, and the cavity of the joint contains a quantity of synovial fluid of varying turbidity. The microscope shows the redness of the membrane to be due to dilatation of its vessels and increased vascularity, and the turbidity of the fluid to be owing to the presence of leucocytes and shreds of fibrinous lymph. As the inflammation advances, the synovial fluid becomes more turbid, the cellular elements increase, and eventually pus is formed. When this stage is reached, however, the process has usually spread to the other joint-structures; the cartilages undergo ulceration, the ligaments soften, and the bones are exposed. On the other hand, the inflammation may subside, and either assume the chronic form or undergo complete resolution and recovery.

Acute suppurative synovitis is usually of septic origin, and is accompanied by grave constitutional disturbance. Rigors (especially if repeated); increased pyrexia, with dry tongue; and œdema of the soft parts round the joint, may generally be taken as indications that suppuration has occurred. See PYÆMIA.

Traumatic synovitis in a healthy person will probably subside, under proper treatment, without suppuration, if there be no wound of the joint. If there be a wound, suppuration is more frequent, and its occurrence will depend chiefly upon whether septic material obtains access to the joint or not. See JOINTS, Wounds of.

Rheumatic synovitis tends rather to adhesion than suppuration.

Treatment.—If the synovitis be of traumatic origin in a healthy person, the treatment should be antiphlogistic and decided. The joint being secured in a position of rest, leeches or cold should be applied. If, in spite of this, the tension remains great, the

fluid should be withdrawn from the synovial cavity by antiseptic aspiration. Subsequently, elastic pressure must be maintained over the joint, and, if fluid remains, blisters will be needed.

In septic synovitis quinine is indicated; and in the rheumatic form, alkalies, the salicylates, and opium.

When suppuration has occurred, and the presence of pus within the joint has been ascertained by tentative puncture, one or more incisions must be made in such a position as will ensure the free drainage of the joint; the cavity must be washed out with antiseptic solution, a drainage-tube inserted, and antiseptic dressings applied. Recovery with a movable joint may ensue, but ankylosis is the more common result.

SUBACUTE SYNOVITIS is closely allied to the acute form both in causation and symptoms, but the process is one of much less activity and virulence, with correspondingly mild constitutional disturbance. Gonorrhœal synovitis, which is a mild form of septic inflammation, comes into this division; and similar forms of articular disease occur in connection with vaginitis, scarlatina, typhoid fever, and other sources of blood-poisoning. See GONORRHOËAL RHEUMATISM.

Here, the *treatment* must be directed to the cure of the source of infection, at the same time that the joint-inflammation is combated by rest, blisters, and pressure. In these cases there is a great tendency to the formation of adhesions, which must be subsequently treated by rupture and passive movement. Some cases of subacute synovitis lead to a persistent, passive effusion into the joint, which resists the ordinary methods of treatment, and is called 'hydrops articuli.' For this, aspiration of the joint, followed by elastic pressure, must be used, and if this fail, the joint may be injected with weak antiseptic solutions, as that of carbolic acid (1 per cent.) or of iodine (1 or tincture of iodine to 10 or 20 of water).

CHRONIC SYNOVITIS may result from the subsidence of the acute forms or from neglect of treatment, but is more often due to some constitutional condition which predisposes to chronic joint-disease.

The *symptoms* are a slowly progressive, indolent swelling of the joint, due partly to fluid in its cavity, but chiefly to thickening of the synovial membrane; slight pain, tenderness, and increase of temperature, and some restriction of movement. As the disease advances, the synovial membrane undergoes pulpy or gelatinous degeneration, and, bulging into all the less resistant

parts of the joint, gives rise to a deceptive sense of fluctuation. At the same time the functions of the joint become increasingly impeded, and the limb correspondingly lame. Eventually, suppuration occurs within the substance or upon the surface of the diseased membrane, and the joint becomes slowly destroyed.

Treatment.—In the earlier stages of chronic synovitis, the treatment will consist in keeping the joint at rest and the use of counter-irritation; while at the same time the health and reparative powers are by all possible means improved. Counter-irritation, as by blisters or the actual cautery, may be followed by pressure in the form of india-rubber bandages or strapping over mercurial ointment. Subsequently friction, shampooing, and passive movement may be used.

But if the stage of pulpy degeneration has been reached, nothing but the removal of the diseased membrane will avail; and this may be done, either by excision of the joint, or by incision combined with scraping or solution, with strict antiseptic precautions. For scraping away the diseased tissue a Volkmann's spoon is the most convenient instrument; for its solution the best method is to introduce into the joint, through lateral incisions, strips of lint soaked in a solution of sulphuric acid in two parts of water.

When suppuration has occurred, the same measures may be used for cleansing the joint; but if the health be much deteriorated and the reparative powers impaired, amputation will be indicated.

J. WARRINGTON HAWARD.

SYPHILIS.—It is important to recognise that syphilis is by no means necessarily a venereal disease. Its various phenomena result from the introduction into the patient's system of a specific poison; and this poison, in all probability, consists of particulate or formed elements. It can be conveyed from one person to another only by direct contact of surfaces. The thinner and more delicate the tissues exposed to this contagion, the more easy is the implantation of the virus. It does not matter in the least upon what part of the body the contagion is effected, for syphilis is always one and the same disease, and is modified in its course only by the inherent peculiarities of the person acquiring it, and the antidotal drugs which are used against it. It is obvious that the venereal act affords peculiar facilities for the transference of a virus of this kind. Hence the fact that syphilis in the vast majority of cases is communicated

in this way, and hence its popular synonym. We meet, however, in practice, with numerous cases in which the contagion takes place upon parts distant from the genitals. See FINGER-CHANCER; LIPS, Diseases of the.

The early stages of syphilis are probably very uniform in their duration; quite as much so as those of the exanthemata. We may conveniently specify these stages as: (1) the period which intervenes between the day of contagion and the first evidence of local change; (2) that which occurs before the full development of local peculiarities; and (3) that which precedes the appearance of constitutional symptoms. Syphilis, like the exanthems just alluded to, is followed in due course, after the poison has had time to breed in the blood, by constitutional symptoms. Those symptoms are febrile disturbance, sometimes acute, sometimes almost absent, an eruption on the skin and mucous surfaces, and transitory congestions or inflammations of the most various organs and tissues. It is customary to speak of the local phenomena resulting directly from the contagion as *primary* symptoms, and of those which follow when the whole blood is poisoned, as *secondary* or constitutional; whilst the terms *tertiary* and *remote* are reserved for a different class of phenomena, which may appear at very various periods after the primary and secondary have long cleared away.

Although, as has just been asserted, the stages of syphilis are, probably, when not influenced by antidotal treatment, very uniform, yet it must be clearly recognised that its severity varies very much in different individuals. This remark applies to all its stages and the whole series of its very varied phenomena. Without any reference to the health of the individual, to his age, to the part inoculated, or to the source of the virus, we may witness, both in the primary and the secondary symptoms, the widest possible differences as regards severity. The secondary stage may be almost fatal in one case and scarcely recognisable in another; the tertiary phenomena never happen at all in a vast number of persons who have suffered very severely in the secondary period, whilst they may affect with great pertinacity, in exceptional instances, those who have suffered very little in the early stages. Differences in treatment no doubt account, to some extent, for these apparent discrepancies, but certainly not for the whole. There remains much which can be explained only by the idio-

synergy of the individual. A similar remark is equally true of the specific fevers known as the exanthems.

The study of the first stage of syphilis has been rendered much more difficult, than would otherwise have been the case, by the fact that its contagion is rarely effected by a pure fluid. In a majority of cases, not only is the particulate virus of syphilis implanted, but with it the contagious products of peculiar forms of inflammatory action. In this way the local or primary symptoms are often complicated, and we witness on the same spot the results of the implantation of inflammatory material and of the true virus. Further, it may and often does happen, that either a contagion from the inflammatory material alone takes place, or that the effects of this entirely overpower and destroy the specific virus which was mixed with it.

THE PRIMARY SORE.—If the virus of syphilis in a pure form be inoculated, it rarely produces any irritation at first. A period of from three to five weeks will elapse before anything is observed. At the end of that time, a little red spot will be noticed, which itches more or less, and which, extending from day to day, soon becomes a papule, and by the end of a week or ten days is probably a little indurated disc or button. The induration is usually very marked, and its margins definite. There is not much surrounding inflammation, and the surface of the ulcer usually secretes but little. In some cases, indeed, there may be no ulceration whatever, and not the slightest secretion. At the end of five or six weeks, from the date of contagion, the induration will be probably marked. It will continue for a longer or shorter period (usually in relation to treatment pursued), but it never, even when wholly let alone, persists indefinitely, and frequently it vanishes after a very short duration. Occasionally it may last for months. The number of these indurated spots, or chancres, will depend upon the number of different places which were inoculated in the first instance, just as is the case with vaccination vesicles. It is not very often that more than one is seen, and if there be two, three, or more, they are always at the same stage of progress at the same time. No new ones are ever produced subsequently to the full development of the first. If, for the sake of experiment, it were attempted by direct inoculation to produce others, the attempt would fail, just as we should fail to re-vaccinate an infant, on the eighth day, from his own spots. See CHANCER.

Simultaneously with the development of local induration, there is usually an enlargement and hardening of the nearest lymphatic glands. If the sore be on the finger, the glands in the armpit will enlarge; if on the lip, those under the jaw; if on the genitals, those in the groin. The character of the enlargement of the glands will be similar to that of the primary sore; that is, there will be great hardening and very little tendency to diffuse inflammation. The glands will remain separate from one another, and more or less movable. The degree of induration will often be such as to justify the term 'bullet bubo.' This term, however, is much more frequently applicable to enlarged glands in the groin than elsewhere. In the armpit and under the jaw the buboes often consist of glands as large as walnuts, and by no means very hard. Suppuration is, however, even less frequent in these regions than in the groin. See BUBO.

The conditions which result from the implantation of inflammatory, or from mixed, products are different. It would appear that some of the inflammations resulting from syphilis, but not attended by the actual presence of the virus, may produce a peculiarly irritating and very contagious secretion. This secretion, if inoculated, promptly produces inflammation. Sores form within a day or two of its contact, which are attended by ulceration, and by the secretion of pus which is capable, in its turn, of inoculating other parts. Hence, these sores may not only be multiple in the beginning, but they may become multiple afterwards. If the experiment of artificial inoculation on some other part of the patient's person be tried, it may easily be proved that he is in no sense protected, since sores of a precisely similar character will be produced. Inasmuch as sores of this kind never show definite induration, they are often spoken of as 'soft'; but it must be clearly remembered that it is quite possible that one or more of them may, at the end of the four weeks' incubation-period, take on induration. It must also be most clearly understood that, although the infecting sore in its typical condition is usually hard, it does not by any means always assume that character. The popular division of sores into 'soft' and 'hard' is productive of very numerous mistakes, since many infecting sores are never hard, and many which are without any trace of hardness at one stage may assume it at another.

The characters of these non-indurated, pus-secreting sores are very various; but

their most usual features are those of an abruptly margined ulcer, having cut or punched-out edges, with a grey, unhealthy surface, and with much surrounding inflammation. It is a remarkable fact, that the non-indurated sore is almost never recognised excepting on the genitals. We must explain this, probably, by the suggestion that the vitality of the pus-elements is much lower than that of the true virus of syphilis. Thus, should they come in contact with the lip or the finger, or even with an abrasion or a wound, they would probably be easily washed off and got rid of. The mucous folds on the genital organs, however, afford the pus a protection, and thus favour the success of its contagion. It may be, also, that non-specific sores on other parts are seldom diagnosed as such, since they present no features which are characteristic beyond dispute. The non-indurated sore, like the hard one, is very prone to cause enlargement of the lymphatic glands, and, as in the former case, this enlargement is of the same type as that of the sore which produced it. It is attended by excess of inflammation. The affected glands swell greatly, and, the intervening tissue being involved, they become glued together in one mass. Suppuration both within and around the glands, instead of being the exception, is the rule.

It is quite possible for a patient to suffer from non-indurated sores and suppurating bubo, without having subsequently any constitutional phenomena. Many such cases occur. It is probable, however, that they are far less common than is generally believed, and that, in a majority of cases, sores which are at first and remain throughout their course diagnosed 'soft,' prove to be infecting. The surgeon must be most cautiously on his guard in giving opinions on this point; for, if the patient has never had syphilis before, whatever may be the characters of any primary sore which he may exhibit, the chances are two to one that the sequel will prove that it contained the germs of true syphilis. The terms infecting and non-infecting, or true chancre and false chancre, might perhaps conveniently displace the adjectives 'soft' and 'hard.' Whatever terms we use, however, we must clearly understand that softness very often precedes induration, that the infecting is not always hard, or, to state it in other words, that the soft may often prove to be infecting. So also with the bubo; an infecting sore may often cause suppuration of the glands, and a non-infecting sore may be attended by a quite moderate degree of enlargement of

glands, which never show any tendency to suppurate. Such being the facts, it is absurd to attempt the formation of sharply-defined rules in the diagnosis of chancre. The general precepts in use are, however, safe enough if we are content to apply them lightly, and careful to remember that they have many exceptions.

It is desirable, at this point, to say a few words as to the relation of the very peculiar disease known as *herpes* to true syphilis. Herpetic vesicles may occur on the genitals of either sex quite independently of any venereal cause, and if they have occurred once they are very prone to occur again. They are seldom or never seen before puberty, and, in those liable to them, they often appear to follow directly on nocturnal emissions or sexual intercourse.

Herpetic vesicles are recognised by their coming out in a group, consisting of at least three or four, by their developing simultaneously and suddenly, and, if time be permitted, by their spontaneous disappearance. Their relationship to syphilis is very peculiar, and often very puzzling. It would appear that they are liable to follow on both kinds of local sore, the non-infecting as well as the infecting one. And although it is to be admitted that those who have never suffered from syphilis may be liable to recurrent herpes on the genitals, yet it is certain that those who have done so are infinitely more prone to it. In syphilitic subjects, further, herpes is often much more severe than in others. Its sores may last longer and become much larger than they would in others, or some of the vesicles may heal and others may persist, and thus it may become by no means easy to distinguish an herpetic sore from a non-indurated chancre. Since herpes very frequently follows intercourse, the patient will often give a misleading history. There is yet another fallacy which occasionally occurs, for in the careless the existence of almost healed herpes may facilitate the introduction of the syphilitic virus, and thus a true chancre or a group of chancres may follow what was in the first instance herpes.

It is necessary, next, to say a few words about a peculiar type of the inflammatory process which is liable to attack both forms of sore—namely, *phagedæna*.

When an ulcer steadily extends in depth and in area, and when its edge presents little irregularities, as if it had been eaten away by a mouse, it is said to be phagedænic. Very often the edge presents, on careful examination, minute points of slough not bigger than pins' heads, whilst

in more exceptional cases there may be sloughing of large and conspicuous portions, and the spreading will be very rapid. To this latter condition the term *sloughing phagedæna* is given.

Sores which are phagedænic are nearly always painful, and the pain is proportional to the extent and rapidity of the process; they are also very liable to bleed, for it would appear that the arteries adjacent to them often fail to get plugged before they are opened by it. If the ulceration extends deeply, and involves vessels of any considerable size, the hæmorrhage may be very profuse.

A certain degree of power to cause the phagedænic type of inflammation appears to attach itself to several specific animal poisons. Thus, the affections called *can-
crum oris* and *noma*, which are forms of sloughing phagedæna, usually occur in fairly healthy children as the sequelæ of measles or scarlet fever. The syphilitic virus, however, stands pre-eminent in power in this direction, and probably nineteen out of twenty of all forms of phagedænic action, which we encounter in practice, are due either directly or indirectly to its influence. See PHAGEDÆNA.

The disease known as hospital phagedæna, which may spread through a hospital, attacking all operation and other wounds, is, not improbably, almost always set going by the admission of a case of syphilitic phagedæna into the wards. The secretions of a phagedænic wound are unquestionably contagious, and they are so not only as regards other individuals, but also in reference to the patient himself. It is in large measure by the contagion of its own secretions that a phagedænic wound continues to spread. Remove those secretions and clean the wound, and the disease will be, in most instances, arrested. In a few cases, however, the constitutional tendency, under which the disease was initiated, is sufficiently strong to begin it again and again, in spite of the most efficient treatment. In these latter cases the use of internal specifics becomes equally important with that of local remedies. See HOSPITAL GANGRENE.

Syphilitic inflammations of all kinds and at all stages, whether primary, secondary, or tertiary, are liable to take on phagedænic action. Its most frequent examples, however, occur in connection with primary chancres. Although it is admitted that it may attack the non-infecting as well as the infecting, the writer cannot quote, from his own experience, any example of a well-

characterised, primary, phagedænic sore which did not prove to be infecting. In this statement reference is made only to chancres occurring in those who have not previously suffered from syphilis, for exceptions occur in those who have done so.

Phagedænic action in primary sores may vary much in different cases, being sometimes slight and easily arrested, at others persistent and extensively destructive. In some cases, it may destroy the whole of the penis; and in a few cases, chiefly in young prostitutes, it may end fatally. It appears to be more apt to occur in sores which are concealed under a long prepuce, by which the secretions are retained. But it may attack sores in any position. Whenever a concealed sore becomes painful or liable to bleed, the fore-skin should be slit up and free access obtained.

Treatment.—As regards indurated primary sores, if the hardness be such as to justify a positive diagnosis, and if, in further corroboration, there be also the bullet bubo, there can be no question as to the treatment. Mercury should at once be given and applied locally, and under its influence there will ensue, in the most definite manner, softening of the indurated patch and healing of the ulcer. If the mercury be stopped, the induration will recur, and if it be again given, it will again melt away. The excision of an indurated sore, or its destruction by an escharotic, can seldom do any harm, but will rarely be productive of good. The virus has already passed into the lymphatic system, if not into the blood, and the occurrence of induration, for the most part, denotes a stage of development too far advanced for any hope of cure by local treatment. The treatment of non-indurated sores will vary according to the stage at which they are seen. If a patient who has never suffered from syphilis before, and who can give his dates correctly, comes under observation at any period within a fortnight of the contagion, with a single sore, it will certainly be wise to destroy it utterly. For this purpose fuming nitric acid may be used, or, still better, the actual cautery; and if the part affected admit of it, free excision by the cautery had better be done. The shorter the period, the greater will obviously be the chance of success. However short the period, success is not certain, as is proved by well-known facts.

The facts alluded to, however, are not of such a nature as to relieve the surgeon of the duty of giving to those patients

who seek his aid early in the case, such chance of escape as the freest possible local treatment affords. If instead of a single one there be many sores, and much surrounding inflammation, there is then no encouragement to commence an abortive local treatment. In these cases, and in all which come under care late, the local treatment will consist in very free washing of the sores and the application of iodoform. This latter drug has superseded all others for the cure of non-indurated or suppurating sores. It should be dusted into the sore after liberal irrigation, and should be applied also as an ointment, one drachm of iodoform to one ounce of vaseline. Perhaps in nine cases out of ten this application will cause the non-indurated sore to take on healthy action and to heal. There are cases, however, which unexpectedly resist it. For such, mercurial applications are next to be tried; and, should they fail, cauterisations with the acid nitrate of mercury may become needful.

Before the introduction of iodoform, a host of remedies were in much repute, but were all of them frequently disappointing. Amongst these may be mentioned the sulphate or chloride of zinc, the sulphate of copper, borax, and various preparations of opium. There are a few cases in which sores, which are not in the least indurated, will yield to nothing but the internal administration of mercury. These are, however, very exceptional; and it may be asserted that, for the most part, the introduction of iodoform has rendered the treatment of non-indurated sores a very easy matter. The same remark applies to the suppurating stage of true chancres.

Several different measures are of the utmost value in the treatment of phagedæna; and, whilst invariably aggressive if left to itself, it is as almost invariably cured by one or another, or all of them combined. In the first place, we have local measures which have for their object the removal of the secretion or its destruction. Amongst these the application of nitric acid, and the use of the continuous bath, are chief. In most cases one or two free applications of nitric acid will stop phagedæna. It is, however, a painful measure, and, in most cases, equally good results may be obtained by keeping the part immersed in warm water. In a bad case, the patient should remain day and night in a sitz bath; but in less severe ones, he may get into his bed for five or six hours at night. When he leaves the bath, the sore should be dressed

with iodoform. Since the occurrence of phagedæna is almost invariably a concomitant of the infecting sore, mercury ought always to be given unless it definitely disagrees. With the mercury should be combined full doses of iron and opium. If it be unquestionable that mercury does disagree, iodide of potassium should be substituted.

Finally, there are certain cases in which a phagedænic sore, although much benefited by the measures enumerated, may yet decline to heal under any or all of them. In these, healthy processes will almost always result if the patient be sent to the seaside. When once phagedænic action is completely stopped it scarcely ever recurs, a fact which speaks strongly in support of the belief that it is, to a large extent, a local process only.

Having thus far considered the peculiarities of primary sores, we may here dismiss entirely the non-infecting or abortive ones, since they are not productive of any constitutional phenomena, and, though associated with it, are not in any true sense syphilis. We may now proceed to the investigation of the very remarkable train of symptoms which follows the infecting chancre.

THE STAGE OF CONSTITUTIONAL INFECTION (SECONDARY).—The chancre and the bubo make up together the primary or local group of syphilitic symptoms. We shall be very near the mark if we say that definite induration in the chancre is rarely present till five weeks have elapsed from the date of contagion, and that secondary phenomena seldom follow till from two to four weeks later still. There is thus a period of from two to four weeks after it has been possible to recognise the infecting sore for a certainty, before the time at which constitutional symptoms will show themselves. If this period has been well employed, if, in other words, mercury has been freely and adequately given, it is probably quite the exception for any secondary symptoms to occur at all. At any rate, if they do, they are but slightly and very feebly marked. The earlier the mercury is resorted to, the greater the probability that they will be wholly prevented. Even when not permanently prevented, they will usually be much delayed.

It must, unfortunately, be admitted that in a certain number of cases, often apparently the most successful, the sequel will prove that delay only has been accomplished. After even a six months' treatment with mercury, and absolute prevention

during the whole of that time, an outbreak may occur when it is suspended. It is this remarkable power of mercury, as an antidote to syphilis, which has led to such different opinions as to the laws of the natural evolution of the malady. If mercury were never given, we should soon see that syphilis is much more regular in its course and stages than is generally supposed. The order of events in cases not interfered with would be probably somewhat as follows: At the end of about six weeks from the date of contagion, the patient would begin to experience slight malaise and feverishness, and his temperature would rise a little every evening. During the next fortnight, if the skin of his chest and abdomen were carefully inspected, it would be found to be mottled by evanescent patchy congestion, not unlike measles, but more dusky and not so conspicuous. To this term syphilitic roseola is appropriate. It is often very evanescent, present at one part of the day and gone at another, or may last only a few days and then disappear. Simultaneously with it, a little later or a little sooner, symmetrical superficial ulcerations on the tonsils occur, and these, too, may be very transitory, and cause so little annoyance that the patient may be scarcely aware that his throat is sore. As the roseola fades, or it may be before it fades, other types of eruption will follow; and a rash composed of little smooth-topped or slightly scaly papules is the most common. The eruption may, however, vary within very wide limits. It may be a lichen, or it may be pustular; or it may take the impetigo or acne type; or it may be vesicular or bullous; or it may assume the rupia type; or it may be corymbiform (the lichen ruber type); or, lastly, it may be indistinguishable from true variola.

We know respecting syphilis that during its early stages the blood and all products of inflammation may prove the vehicles of the contagion. How long this condition persists we do not know. That the blood may still be contagious, after all external phenomena have vanished, we know from the facts of vaccination-syphilis, and from many instances of accidental inoculation. A vast amount of negative evidence favours the belief that the normal secretions, the saliva, the milk, the sweat, the semen, are not usually, perhaps never, vehicles of contagion. If they were so, syphilis would be far more common than it is. The rarity of the lip-chancere is an almost conclusive fact against the contagion of the saliva. So also, as regards the semen, is the fact

that syphilitic husbands do not usually communicate the disease unless pregnancy ensues. Yet, it is unquestionable that the virus exists in the semen in a manner which permits of spermatie infection of the embryo. It is possible, however, that this may be a very different thing from the infection of a wound.

A very large amount of negative evidence supports the belief that the virus ceases to exist, in a form efficient for contagion, long before the subject of the disease is free from the risk of relapses. Almost all the examples of accidental contagion occur within short periods from its origin. It is seldom that more than two years can be proved under such circumstances. The primary and all secondary lesions are certainly contagious, and during their persistence the blood is virulent, but after they have ceased, whether from treatment or without, there is reason to believe that the virus does not long remain potent for contagion. No instances of contagion from a tertiary lesion, or from one produced more than five years after the primary disease, are, as far as the writer's knowledge extends, on record. Perhaps the period might be shortened to three years. Yet, long after such periods, the patient continues to be himself liable to various forms of local inflammation consequent on his taint.

The older writers inferred that a man might have syphilis over and over again. Five-and-twenty years ago it was taught, almost universally, that one attack secured immunity from others. We are now again coming back to the old belief. At any rate, we know for certain that second attacks are not very infrequent. The writer has himself had not a few opportunities for observing the course of second attacks, in patients whom he had himself seen during the first. The doctrine that immunity is conferred is, however, to some extent, well founded. Second attacks are exceptional, and when they do occur the disease is almost always modified. Second chancres do not run the usual course. Their induration is often developed quickly, and very quickly passes away, to be followed by nothing definite. For the most part, second contagions result only in non-indurated or abortive sores. Yet, in spite of this being the usual course of events, it is, beyond doubt, quite possible for a man to have complete syphilis twice. Perhaps it is as infrequent as in the case of variola, and to be explained, as in the latter instance, by the idiosyncrasy of the patient. It curiously happened, in the first instance in which the

writer observed a second attack of syphilis, that the patient had experienced two attacks of variola also.

One of the occasional manifestations of secondary syphilis is the production of papillary warts. The fact that we encounter not only the most various modifications of the inflammatory processes, but also conditions which are in the main produced by structural overgrowth, is so remarkable that the writer must refer to it in some detail. The warts which we see in the middle of the dorsum of the tongue are the most simple and definite example of this structural enlargement. They are often unattended by inflammatory infiltration of adjacent parts, and consist simply of hypertrophied papillæ. They wither when mercury is given. Now and then similar warts, directly due to syphilis, are seen on the genitals, and sometimes (but very rarely) the whole skin-eruption assumes a papillary type. The condyloma is, however, much more common than the ordinary wart. It is indeed a variety of wart, and between it and the typical *verruca mollis* we observe all gradations. In the condyloma there is great hypertrophy of papillæ, but these are concealed by the extensive cell-infiltration into the intervening layers. The great thickening of the intima, which occurs as the first stage of syphilitic arteritis, is also, in many instances, a condition of hypertrophy rather than of inflammation. The same remark applies to some of the cases of hypertrophic cirrhosis which we meet with in syphilis, in which there is much diffuse fibrous overgrowth. This fibrous overgrowth may vary much in the amount of its cell-infiltration. The term 'mucous patch,' often used as synonymous with condyloma, should be superseded by mucous wart or papilloma. Many, indeed by far the greater number of true mucous patches, are not attended by any papillary growth. See MUCOUS PATCHES.

Thus, it may be said that the syphilitic virus often causes sclerosis or sclerotic hypertrophy in the first instance, and inflammation, more or less marked, in the second. Sometimes no inflammation occurs, and the chancre may run its course without pain or irritation, without ulceration, and without discharge. Such were probably the conditions, as regards the chancre, in some of the cases in which intelligent and truthful patients, affected by unquestionable syphilis, assure us that they have never had any local sore.

The indurated chancre does not present any features peculiar to itself when ex-

amined by the microscope. It is simply an example of cell-infiltration without giving way of the cellular-tissue fibres amongst which the cells are effused. Hence, perhaps, the explanation of its hardness. Inflammatory action is almost absent, and the process resembles that of a new growth. The hardest chancres are always those which are least inflamed.

In the false chancre, on the contrary, the pus-elements which effect the contagion produce inflammation from the beginning. Even if the specific virus be present also, it is very possible under such conditions that it may be unable to effect any noticeable degree of sclerosis, and thus, as already observed, the sore may rank as soft or suppurating, although it may prove infecting.

At the same time that the skin is affected in constitutional syphilis, the eye, the periosteum of the bones, the bones themselves, the joints, the nervous system, indeed all the tissues of the body, are liable to suffer. Whatever part is attacked, however, the inflammation, although persistent for a certain time, will usually prove transitory in character. Very often, the duration of the phenomena at this stage is exceedingly brief. Just as the patient may have a roseola which lasts only a few weeks, or even only a few days, so it is with periosteal pains, with affections of the eye, and with those of the nervous system. What happens may be a merely temporary congestion, and by no means a definite inflammation. In this, we note a strongly marked difference between all the occurrences in the secondary stage of syphilis and those which are tertiary. The latter, unless cured by treatment, invariably persist, and tend to spread locally. The former, although often for a time very severe, as invariably show a tendency to subside spontaneously.

Other important distinctions between secondary and tertiary syphilis must be insisted upon. The phenomena of the secondary stage are caused by poisoning of the blood, and of the tissues generally through the blood; they are therefore almost always symmetrical, and are developed with accurate sameness of appearance on the two halves of the body. In the tertiary stage it is highly probable that the virus has ceased to exist in the blood, and, in an active form, even in the tissues themselves. Thus, in this stage the phenomena are due to peculiarities, which have been stamped upon the tissues by what occurred during the more or less remote period of blood-poisoning. Local influences have

much to do with the bringing out of these inflammations, but when once produced they are always self-infective, and tend not only to persist, but to advance in adjacent tissues by 'contagion of continuity.' As an example of this may be adduced the well-known horse-shoe sore, a form of syphilitic lupoid affection of the skin, always tertiary, and always tending, unless stopped by treatment, to spread at its edge. To this quality of edge-spreading the term *serpiginous* is applicable, and the *serpiginous* tendency is one of the most important features of difference between the tertiary phenomena of syphilis and those which are secondary. One which is perhaps still more important is, that the tertiary symptoms are, as a rule, not developed with symmetry. They depend far more upon local causes than do the secondary. Thus, there is no reason why they should be symmetrical, and, in fact, they are only exceptionally so. Even when an accidental symmetry is observed, we never witness with it the general distribution, which is another marked feature of the secondary symptoms. As a rule, we may note, also, that the inflammations which occur in the secondary stage do not spread at their edges, are not *serpiginous*—a feature in which they resemble those of the other exanthemata. The only exception to this occurs in the case of phagedænic ulcerations, and in these, as has been already explained, the phagedæna is not in a strict sense part of the syphilis, but is due rather to certain peculiar forms of inflammatory secretion which have been produced by it. Thus, if phagedænic action should occur in the secondary stage, it never shows any tendency to symmetry of arrangement.

It is desirable now to attempt a more detailed description of the symptoms which we meet with in the secondary period.

THE ERUPTIONS ON THE SKIN IN THE SECONDARY STAGE present so many features of difference that it would be tedious to attempt their separate description. It is a most interesting and remarkable feature, respecting the skin-diseases of syphilis, that they do not, as do the other exanthemata, keep to one form. There is, in fact, no single skin-disease of constitutional origin which may not be imitated very closely by an eruption which is due to syphilis. Certain general features of distinction may, however, be noted. First, the imitation is rarely absolutely correct. However close at first sight, the careful observer will almost always note some distinctions, and thus will usually know what name to apply.

Next, there is very frequently a mixing of the types of two or more in the same case. Thus, as is well known, syphilitic eruptions are very commonly polymorphous. We see mixed in the same case, and often in close juxtaposition, papules of psoriasis and of lichen, or the rash may be in part lichenoid and in part pustular. There is a popular belief that the eruptions of secondary syphilis are always of a peculiar colour—a coppery tint, or the colour of the lean of ham, is supposed to constantly characterise them. No doubt this peculiar feature is very often observed, but it is far from invariable, and it is often exceedingly well marked in eruptions which have no relation to syphilis. Those who trust to it, therefore, will be in constant danger of making mistakes. In judging of the colour of syphilitic eruptions, allowance must be made for the temperament of the individual and for the part of the body on which the eruption shows itself. So far as the tint shows itself in pigmentation, we may say that the darker the complexion of the patient the more likely will his eruption be to show a deep copper tint. On the lower extremities, where the venous circulation is at a disadvantage, patches of syphilitic eruption will always be much more dusky, owing to venous congestion, than on other parts.

Next to colour, symmetry, and polymorphism, we have to mention the position on which the spots appear, as aiding us in the diagnosis of secondary syphilitic rashes. The earliest forms of eruption, roseola, &c., unquestionably occur on the front of the abdomen, and throughout the whole course of this stage the front of the trunk is very rarely exempt. Very probably the wearing of clothes, especially of woollen, and the warmth of the surface thus preserved, have much to do with this peculiarity of location. We seldom see the early secondary rashes on the face or hands, and if they do occur here it is only in cases of exceptional severity. Next in importance to the abdomen and front of the chest, we have the front surface of the arms; indeed, no region of the body is more constantly affected by secondary syphilis than these parts. The back and sides of the neck are very frequently affected. Although we may, without hesitation, draw a strong line between common psoriasis and syphilitic psoriasis, by saying that the latter usually affects the fronts of the upper extremities and the backs of the lower ones, while it is the reverse in the common form, yet the rule is liable to many exceptions.

Whenever we find psoriasis patches definitely located on the tips of the elbows and fronts of the knees, we may be confident that it is non-specific, but we shall meet with constant exceptions to all other rules as to diagnosis by location.

Next in frequency to the roseolous or blotchy eruption so common in the very earliest stage of secondary symptoms, we must place the papular rash, to which the name psoriasis is usually given. It differs from non-syphilitic psoriasis not only, as just observed, in the localities affected, but also in its general characters. It seldom, like common psoriasis, affects large areas, but is usually seen in small spots (from a pea to a sixpence in size), and it is never conspicuously scaly. The white silvery scale-crust usually present in the non-syphilitic form is seldom seen in the specific one. Not infrequently the papule, upon which the scales are scantily placed, shows so much thickening that the term tubercle might become appropriate. From these features, and from the fact that the various spots often differ a good deal from one another in the same individual, it is not often difficult to make the diagnosis, even without help from the history of the case. Amongst the less common of the syphilitic rashes we have the following:—

In *lichen* we meet with little red or dusky pimples scattered over the whole surface. They are often very thickly placed, but show little or no tendency to arrangement in groups, and seldom become confluent, or form patches. There is, however, a form of syphilitic lichen in which the spots are arranged in long, corymbose groups, or in streaks, exactly resembling those seen in lichen ruber, and sometimes these become flat-topped and polished as in lichen planus. The exact imitation of these peculiar forms of skin-eruption by syphilitic rashes is very remarkable, and the diagnosis is often exceedingly difficult. The mistake most usual is taking the non-syphilitic eruption for a specific one, and rejection of the patient's denial that he has ever run the risk of acquiring the latter. Lichen ruber and lichen planus are often dusky or copper-tinted, and present all the features which, to those of limited experience, suggest a confident diagnosis of syphilis.

Although a syphilitic eruption, looking closely like *small-pox*, is very rare, yet the knowledge of its possible occurrence is of extreme importance. The imitation, when it does occur, is very perfect. The papules are elevated, shotty to the finger, have depressed centres, affect the same regions as

variola, and resemble it so absolutely that nothing but the history of the case can help the surgeon to a correct opinion. In proof of this statement, it may be stated that it is not at all unknown for patients presenting this type of syphilitic eruption to be sent to the small-pox hospitals, and there to obtain admission and prolonged treatment. This simulation of the variolous eruption by syphilis is the most marked example of 'syphilitic imitation' which can be adduced, but it is only one of many. By far the easiest clue to the recognition of the syphilitic skin-diseases is the acceptance of this general law: *Syphilis may imitate all known forms of skin-disease, but it can produce no originals.* All the known names for skin-diseases (excluding those of merely local origin) may in turn receive the adjective *syphilitic* before them. When they do so, that adjective becomes, of course, all important, and wholly swamps the designation to which it is appended. Of the exanthemata, not only variola but varicella, rubeola, and scarlatina may be thus imitated. The rash caused by copaiba is often exactly like a syphilide, or, what amounts to the same thing, syphilitic rashes are like it. Forms of inflammation, exactly like those called lupus, are very common as the results of syphilis, and it is the same with alopecia, leucoderma, true leprosy, and many others. We see here the importance of a correct appreciation of the patient's history. When any one of the evanescent eruptions is simulated by syphilis, the mere lapse of time clears up the diagnosis, though unfortunately often not early enough to save the surgeon's reputation. The supposed variola or copaiba rash does not fade at the proper time, but persists for weeks together, and thus proves itself a syphilide.

The eruption known as *rupia* is an important and peculiar one. The term *rupia prominens* was formerly in use, as applicable to the conical, limpet-shell-like crusts which characterise this eruption. *Rupia prominens* is of all others the most easy skin-disease to represent in a portrait, and good pictures of it occur in all atlases. It can scarcely occur excepting when the treatment has been neglected. *Rupia* is rarely the original form of eruption, but usually results from the ulceration of papules. This ulceration, gradually extending at its base, and producing a secretion, which is not very abundant but which quickly dries, causes the crust to enlarge in circumference and increase in height. Sometimes, and in the most typical cases, a bulla precedes

the formation of a crust. Rupia invariably leaves scars, and they are almost always round. There has been much misapprehension as to whether rupia should rank as a secondary or a tertiary form of eruption. In conformity with the old error that all forms of ulceration should rank as tertiary, it was commonly classed as such. We now know, however, that this feature will not help us. Many secondary lesions, both of skin and mucous membranes, ulcerate, and the chief distinction between secondary and tertiary is as to time of occurrence. Bearing this in mind, we may admit that rupia never occurs very early amongst the secondary phenomena, and that it is almost always preceded by some other form of skin-eruption (roseola, psoriasis, &c.), nor, on the other hand, is it ever seen amongst the late and well-characterised tertiary phenomena. Its usual place is from six to twelve months after the chancre, and in patients who have failed in health under treatment. Sometimes it will persist for long, but, even when it does so, it usually continues to be general and symmetrical.

Whenever an eruption displays these features, and occurs within two years of the chancre, it must rank as secondary, and such is the usual position of rupia. The scars left by it often help us much in the positive recognition of syphilis in patients who have reached the tertiary stage. Such patients do not, however, with the very rarest exceptions, show any rupia patches still extant. If we are careful to diagnose between rupia and certain forms of lupus which somewhat resemble it, we shall be obliged to admit that it belongs almost exclusively to the position assigned to it, and is simply a suppurating modification of a secondary rash. The explanation of the tendency to suppurate is to be sought in some peculiarity in the patient's health, and his susceptibilities to the influence of mercury and iodides. Each of these drugs may in turn appear to aggravate it; and not infrequently it has been developed during their use. The indication is always for the combination of tonics, steel, quinine, or opium, and, above all, for resort to sea air. It is a great mistake to assume, as was formerly done, that mercury is to be avoided when syphilitic sores ulcerate. On the contrary, when used in the associations suggested it will almost always prove the means of cure.

No other conjecture can be given, in explanation of the differences in the eruption which attends syphilis, than that they depend upon the idiosyncrasy of the patient.

They certainly have nothing to do with differences in the poison, for, so far as we know, none such exist. The different types of syphilitic eruption never prevail epidemically, but, as it were, quite by accident. The rare ones are equally rare, and the common ones equally common, at all times and in all places. Nor do differences in health suffice to explain them, for the most severely ulcerating forms sometimes happen to patients who, both before and after their occurrence, appear to enjoy robust health. On the other hand, delicate persons often suffer very lightly from syphilis.

OF THE AFFECTIONS OF THE EYE IN THE SECONDARY STAGE, *iritis* is by far the most common. It usually occurs from three to six months after the chancre, and is thus distinctly secondary. It seldom attacks the two eyes simultaneously, but the second usually suffers after a short interval, and often in spite of successful treatment of the first. The symptoms are, ciliary congestion, a muddy iris, an irregular pupil, and a variable degree of pain and photophobia. Of these, in slight cases, the demonstration of iritic adhesions by the use of atropine is by far the most important. Sometimes, the case never passes the stage of a slight ciliary congestion, which may be gone in a few days. In others, the attack may be attended by severe pain, great congestion, a thickened iris, nodules of rust-coloured effusion in its structure, and a blocked pupil. The result, even in severe cases, is usually restoration of almost perfect sight, but in many instances the eye is damaged, and in some it is destroyed. There is usually but little tendency to relapse when once the cure is well in progress, and it is but very seldom that the disease lapses into a chronic form. In severe cases the vitreous may be affected, and in a few the choroid and the retina are inflamed at the same time. More usually, however, these structures suffer at a somewhat later period, and when the iris is not itself inflamed.

The diagnosis of syphilitic from other forms of iritis must depend to a large extent upon the patient's history, and concomitant symptoms. There is nothing in the symptoms distinctive from those which occur in the arthritic form. The little gummata or nodules in the iris are, when they occur, pathognomonic symptoms, but they are seen but rarely. Arthritic iritis is, as a rule, attended by much more pain and intolerance of light than is the syphilitic form, whilst the iris is usually less swollen and less muddy. Effusion into the aqueous humour and dotted deposits in the back of

the cornea may occur in both. The history of repeated recurrences (once or twice, perhaps, every year) is very common in the arthritic form, and never occurs in the other. The first aim of treatment in syphilitic iritis is to secure dilatation of the pupil, and for this object atropine drops, four grains to the ounce, must be used every two hours the first day, and less frequently afterwards. The constitutional treatment must be, as for other secondary symptoms, the use of mercury. Iodide of potassium in full and increasing doses will often effect a rapid cure, but it is less certain than mercury. For a patient who was not previously under the influence of either, one grain of the grey powder in pill every three hours, until the gums are touched, will be an efficient treatment. In the meantime the patient should keep his room, live abstemiously, and, if the pain be severe, have leeches to the temple. If it is desirable to combine opium with the mercury, care must be taken that constipation is not induced. On the other hand, diarrhoea is to be avoided. The safety of the eye depends, however, mainly upon the promptitude and efficiency with which atropine is employed. *See IRIS, Diseases of the.*

At a later period (rarely till a year from the date of contagion) the eye may be attacked by *neuro-retinitis* or diffuse retinitis, or by patchy choroiditis (choroiditis disseminata). These affections may occur after iritis has passed off and all treatment been put aside, or in cases in which iritis has never happened. They are both of them rare, and in each case the objective diagnosis must be made by the ophthalmoscope. In both, the subjective symptoms are simply more or less failure of sight with muscæ, but without much evidence of congestion, and with little or no intolerance of light. In both, the prompt use of mercury to ptialism is urgently demanded. This will in most cases effect a cure, often with but very little damage to sight, and with little or no risk of relapse. These forms of retinitis are frequently attended by some opacity of the vitreous. *See CHOROID, Diseases of the; RETINA, Affections of the.*

We have to observe respecting the *mouth and mucous membranes generally*, as in the case of the skin, that various stages of different symptoms are observed in secondary syphilis. The earliest, and usually the very first of all secondary phenomena, are ulcers in the tonsils. These occur symmetrically, and are often very superficial, and almost painless. They are often present without the patient knowing that he

has sore-throat, and often pass away very quickly. The condition is usually a kidney-shaped ulcer, with grey-white borders, like 'snail tracks.' Their presence often helps the diagnosis of constitutional syphilis in its earliest stage. They are usually coincident with the erythematous or roseolous rashes, and, like them, soon pass away. It is not, however, in all cases that they pass off so easily, and when they do so they are often followed by other and more troublesome forms of inflammation of the mouth and throat. It is a very remarkable fact that the syphilitic poison, when freely developed in the blood, can cause not only local inflammations and ulceration, but local growth. These differing processes may often be seen, side by side, in the mouth of the same patient. Patches may form on various parts of the lining of the cheeks and lips, on the gums, and on the tongue, which are simply attended by congestion, slight swelling, and abrasion. These are known under the name of the mucous patch. Upon them we sometimes witness the destruction of the proper papillæ of the tongue, causing the 'bald patch,' whilst in other cases the papillæ are hypertrophied. This hypertrophy may produce either warts or condylomata. Between these the chief difference is that in the latter the overgrown papillæ are fused together by swelling of the intervening tissues, and a flat-topped, elevated area is thus produced, whilst in warts the papillæ are free. There is one particular part of the tongue in which warts are specially prone to grow during syphilis. This is the central region, a little in front of the circumvallate papillæ, which, when the tongue is at rest in the closed mouth, is least in contact with other parts. It is not possible, excepting by the history, to distinguish warts due to syphilis from those in connection with other causes. In the case of the condyloma the diagnosis is usually easy, for nothing resembling it is ever produced, excepting in syphilis.

At the same time that the mouth suffers, the other mucous orifices are very likely to be affected. On the vulva in women, around the anus in both sexes, and under the prepuce in men, mucous patches, condylomata, and warts are very frequently seen. The same remedy which causes the abrasion to heal, and covers the bald patch with freshly-grown papillæ, will also cause the hypertrophies present in warts and condylomata to undergo shrivelling. Thus we may feel sure that both the atrophy and the hypertrophy were the real

results of the syphilitic poison. The development and persistence of syphilitic lesions in the mouth will be much influenced by local conditions. They are far more frequent in smokers than in others, and are also more severe and more lasting. Broken teeth will also often locate syphilitic sores on the tongue or cheeks, and cause them to persist when they would otherwise have healed.

The *tongue* in smokers, and occasionally in those who do not smoke, is apt to pass into a condition of chronic disease. This may assume various forms, being sometimes attended by much general swelling, causing bossy projections, with deep sulci between them, whilst in others it is a superficial change, leading to permanent baldness and sclerosis. The leucomata, or persisting, smooth, white patches, so often seen, must be regarded as the joint result of syphilitic glossitis, and the constantly-recurring irritation of hot tobacco-smoke. In a majority of cases the latter probably takes the larger share. See PSORIASIS BUCCALIS; TONGUE, Diseases of the.

The *periostitis* which occurs in the secondary stage of syphilis differs from that of later periods in that it is usually slight in degree and transitory. Definite nodes are very rare. It is common enough, however, for patients in this stage to experience pains in various bones, attended by tenderness on pressure, and sometimes slight swelling—osteocopic pains as they are sometimes called. Rheumatoid pains are also common, and in some cases very severe. Under specific treatment, however, or even without it, these bone and joint affections pass completely away and leave no permanent results. The bones usually affected are precisely those most prone to suffer later on—those of the skull, the tibiae, and the clavicles. When rheumatism is severe in the secondary stage of syphilis, it occurs probably to those in whom there is an inherited tendency to arthritic diseases.

Loss of hair, a general thinning over the whole scalp, sometimes with a tendency to fall in patches, is a very frequent symptom of the secondary stage. It is sometimes attended by affections of the nails. It is usually arrested by the use of mercury, and the hair grows again as well as before.

Not a few patients during the secondary stage of syphilis become a little *deaf*, sometimes in one ear, sometimes in both. In most cases the condition is merely temporary, often lasting only a few days. In exceptional instances, however, absolute deafness is rapidly produced, and is per-

manent. Nothing but the rapid and vigorous use of mercury can save the function in these cases. When severe, both ears are almost always affected. Few, if any, opportunities have occurred for dissecting the ears of those who have become deaf in the manner described, and we have, consequently, no conclusive evidence as to the precise nature of the malady. It may be assumed that it is an affection of the internal ear, and that it is the same as that in the form of deafness which we meet with much more commonly in inherited syphilis. It usually occurs within a year of the primary disease. We do not know of any form of deafness due to syphilis which occurs in the tertiary stage of the acquired form. In the inherited disease, symmetrical keratitis and symmetrical deafness are both of them very common at or about the period of puberty. Although occurring so many years after birth, yet their constant symmetry seems to prove that they belong really to the secondary group. See CONGENITAL SYPHILIS. Keratitis and deafness in the acquired disease are almost infinitely rare, but when they do occur it is in the secondary period, and they are symmetrical.

Menière's disease is now and then closely simulated, or perhaps we ought to say produced, by syphilitic affections of the ear. See EAR, INTERNAL, Diseases of the.

A large number of those who suffer from constitutional syphilis pass through the secondary stage with very little disturbance of general health. They scarcely know that they are ill. With a minority, however, it is otherwise. Severe pains in the bones and joints occur, there is loss of appetite and failure of strength, and, above all, very marked rise of temperature every evening. These indications of constitutional disturbance are, sometimes, quite out of proportion to the skin-eruption and the other local conditions. It sometimes happens that a patient is confined to bed, and supposed to be the subject of some obscure 'blood-poisoning' with high temperature for weeks together, before the development of a characteristic rash reveals the real nature of the disease. Dr. Duffin, of King's College Hospital, was, probably, one of the first to study systematically the occurrence of febrile temperatures in association with syphilis. A very remarkable example of temperature ranging from 99·8° F. to 105° F. for several weeks was recently brought before the Clinical Society by Dr. Burney Yeo, of the same hospital. Probably, in almost all cases in the early part

of the secondary stage, if the thermometer were regularly used, we should find some tendency to evening exacerbation. Although the fever is sometimes disproportionate to the eruption, it is to be admitted that they are more usually in ratio with each other. The variola-like eruption in particular is almost always attended by much fever, and, indeed, wherever the eruption is unusually free, whatever may be its type, there is commonly more than usual fever. This occurrence of high temperature, simultaneously with the exanthem, is another of the numerous facts which support the belief that syphilis ought to be classed with the specific fevers.

INTERMEDIATE SYMPTOMS.—All the usual phenomena of the secondary stage pass away, in most cases completely, under treatment. In a very large majority, at the end of six months from the date of contagion the patient is again in good health, and apparently quite rid of his disease. Unfortunately, however, in a large number relapses occur, and the patient becomes liable to what have been well designated 'reminders.' These symptoms are of a kind far less severe and aggressive than most of those known as tertiary, and they often in some features ally themselves with those of the secondary stage. Thus they often display themselves symmetrically on the two halves of the body and on the limbs. They seldom, however, resemble the secondary symptoms closely: thus nothing is less common than to see a patient, who has been cured of syphilitic psoriasis or lichen, display the same again in its original characters. The 'reminders,' to which reference is made, usually consist of peeling patches in the palms, sores on the tongue, patches on the scrotum, or it may be a scanty papular eruption over the whole surface. Sometimes sarcocoele or gumma of the testis occurs in this association, but more commonly it is later. A very curious liability to a slight and short-lived eruption of erythematous rings is not infrequently noticed. These rings occur on the arms and trunk, and are especially visible after exposure of the surface to either heat or cold. They are noticed just after getting out of bed in the morning or just after a bath, whether hot or cold. The eruption rarely remains out more than an hour, often only a few minutes, but it returns over and over again. The syphilitic nature of this curious eruption is often proved by the entire disappearance of the liability to it after a short course of mercury.

Psoriasis Palmaris.—Peeling patches in the palms often occur during the secondary rash, but more usually they are seen somewhat later. The earlier they happen in the course of the disease the more likely they are to be symmetrical, and the more easily will they be influenced by mercury. On the other hand, the longer the interval the greater is probably the share of local causes, and the more difficult the cure. There is a form of palmar psoriasis which is distinctly tertiary, almost always one-sided, and in which the patches show a tendency to spread serpigiously. It is to some extent a mistake to call the palmar patches by the name of psoriasis. They seldom if ever show any tendency to scale-accumulation, but rather to peeling and destruction of tissue. In the secondary stage, however, numerous separate patches are seen, and although there is never any scale-crust, yet their co-existence with psoriasis on the trunk and limbs seems to denote sameness of type with that eruption.

The form of syphilitic psoriasis which occurs late in the disease, which affects only one hand, is attended by a dusky thickened edge, and which spreads out at its border, assuming the horse-shoe form, is more nearly of the lupus type. It is distinctly tertiary. It may be here remarked, that it is a great mistake to suppose that all forms of palmar psoriasis are syphilitic. In a majority of cases peeling patches in the palm have nothing to do with syphilitic taint, but are in connection either with the dartrous state, with senility, or with purely local influences. See PSORIASIS.

Sarcocoele from gumma of the testis is an affection which occurs under much the same conditions as palmar psoriasis. If both testes are affected, the interval since the primary disease will usually be found to have been but short; but if only one, it may have been of several years. Syphilitic affections of the testis are seldom seen either in the early secondary, or later tertiary. They belong distinctly to the intermediate group. In this affection we sometimes meet with distinct masses of deposit in the epididymis. The most common condition, however, is a general enlargement of the whole gland with a smooth rounded exterior. The size attained may be very considerable, possibly as big as a small fist. The enlargement is slow in development, and usually painless. Abscesses may occur if no treatment is resorted to, and these may lead to fungus testis. The syphilitic testis may often be known by its large size, peculiarly rounded outline, and

light specific gravity. A gumma feels decidedly lighter in the hand than either hydrocele or malignant growth. However large the swollen gland may be, and however long the disease may have persisted, the surgeon should never despair of the cure by specifics; mercury and iodide of potassium are both useful, and under their influence the largest and most threatening forms of sarcocoele will melt away. The same remark must be extended to cases in which abscess has occurred and been followed by fungus testis. It is never necessary in such cases to excise the gland, however hopeless the condition may look, for under the influence of treatment a cure, so far as a cure is possible, can almost invariably be brought about. See TESTIS, Diseases of the.

It is during this intermediate period that *choroiditis*, if it occur at all, is likely to happen. It is, however, a very rare affection. Sometimes distinct gummata in the choroid may be demonstrated by the ophthalmoscope. These, under specific treatment, may be observed to disappear rapidly, leaving more or less conspicuous scars and patches of atrophy. In other forms, thinning and absorption of the choroid occur without any evidence of previous gummata. With the *choroiditis* there may be inflammation of the retina or optic nerve, or these latter may occur alone.

Inflammation of the *arteries* in syphilis may occur either as an affection chiefly of the intima or of the adventitia. The middle coat, as a rule, escapes. When the inner coat suffers it becomes thickened, either in plates, or over long tracts, much as in the early stages of non-specific sclerosis. There are no special characters by which the syphilitic form may be distinguished, if we except the general fact that the cell-effusion is usually excessive in syphilis. The changes may advance so as to almost close the artery, or they may lead to ulceration, the detachment of emboli, and the formation of thrombus at the seat of disease. These processes have been chiefly studied in connection with the arteries of the brain, but they may occur in any part. As a primary and independent affection, disease of the intima is probably far more common than that of the external coat. If, however, the arteries be affected secondarily (that is, are involved in association with disease of the tissues in which they pass), then, usually, the adventitious coat suffers first and most severely. It also is the most likely to suffer if arterial

disease should occur late in the course of the malady.

Cerebral disease, consequent on disease of the walls of the vessels, is a very distinct affection from the other brain and nerve disorders which occur from syphilis. It almost always assumes somewhat of the nature of a 'fit.' The arterial condition is one of thrombosis, not of laceration. From this fact it follows that the paralysis (usually hemiplegic) comes on, not suddenly as in hæmorrhage, but somewhat gradually. As the vessels become more and more nearly occluded, the patient experiences tingling, or twitching, or numbness in the limbs about to be affected, and this may last some hours before all power is lost. Now and then, however, the seizure is very sudden. A certain amount of recovery may be confidently expected from this form of paralysis; but it will seldom be quite complete. It not infrequently happens that the patient experiences no relapse, but remains through after-life with a weakened or possibly contracted arm.

It is probable that all the *viscera* are liable to suffer during the latter part of the secondary stage, or even sometimes in its earlier part. They suffer, however, in a manner very different from that which occurs in the tertiary stage. No large nodose gummata are formed, nor are any of the conditions produced at this stage, as a rule, permanent. The process is one of diffuse infiltration, with general congestion, rather than of local growth. The congestion, swelling, and ulceration of the tonsils is the first and commonest evidence of tendency to visceral affection. A little later, there may be engorgement and tenderness of the liver and spleen, and a remarkable failure in the blood-making process. Slight and transitory albuminuria may occur, or there may be symptoms of impending lung-mischief. All these conditions are rapidly and easily remedied by the administration of mercury. After they have passed away, the patient may remain well for several years before the gummata which characterises the tertiary stage begin to appear.

It was formerly thought that all syphilitic affections of the *nervous system* came late in the disease, and were distinctly of the tertiary class. We now know that this is to a large extent an error, and that it is not at all infrequent for patients to suffer from implication of the cerebro-spinal system in comparatively early stages. Alfred Fournier has described a very peculiar form of general analgesia, which is not uncommon coincidently with the eruption, and the ophthal-

moscope has demonstrated the existence of retinitis in many instances soon after or even before the end of the first year.

TERTIARY SYMPTOMS—The division of syphilis into stages is to some extent arbitrary, but for the most part it accords fairly well with clinical observations, and no one can doubt that it is practically convenient. The specification of the primary symptoms is easy, and all will admit that they, at any rate, do not (with rare exceptions) recur after disappearance, or mix themselves up with the later stages. So also of the secondary symptoms. Every one recognises a copious, symmetrical, copper-tinted eruption, and symmetrical superficial ulcers in the tonsils, as characteristic of an early period, and, as a rule, not in the least likely ever to re-appear in the same form if once they have completely disappeared. If a good interval of immunity has occurred, they will certainly not re-appear, but early recurrences are not so infrequent as in the instance of the primary symptoms. Although, in the present day, with the all but universal employment of mercury, we but seldom have the opportunity of witnessing spontaneous disappearance, yet we may feel certain that, like the primary stage, the secondary one has its limits of duration, and vanishes after a time spontaneously. In the stage which we are now about to consider, no such tendency to spontaneous cure is observed, and unless the physician intervenes with his remedies, the morbid processes, once initiated, continue to progress. Certainly, we have here a very important and quite natural feature of difference between the secondary and tertiary forms of disease. When we add that the tertiary are, as a rule, ranged without symmetry when multiple, that they are often few in number, or even single, and that we frequently observe them after an interval of immunity extending over many years, it will be yet more clear that they constitute a separate group. We make no distinction as to the tissues affected, asserting that all the tissues, or any single tissue, may suffer in either of the stages. It is not a question of the tissue attacked, but of the peculiar types assumed by the morbid process, which constitutes the difference.

As regards the stage which the writer has ventured to name intermediate, it is far less easy to separate it on the one hand from the secondary, and on the other from the tertiary. As its name implies, it stands between the two, and it partakes of the nature of both. Its phenomena are some-

times symmetrical, at other times not so, some of them disappear without specific treatment, though most of them, probably, do not. This stage may begin before the secondary is well over, and may be prolonged until that which is definitely tertiary begins. If it were practicable to use inoculation experiments as a test of stage, we might, perhaps, be able to distinguish definitely. In the primary stage, the local lesion is alone capable of conveying the contagion to another person; in the secondary stage, the blood and all fluid tissue-elements contain the virus, whilst, in the tertiary stage, contagion is probably not possible. The precise date at which the blood ceases to be the vehicle of contagion might be claimed as the end of the secondary stage. In most persons, probably, it occurs between the end of the first year and the second. In some it may be much later. Thus, then, we have clear rational data for the division of the stages. In the primary stage, syphilis is for a short time a local disease; then, in the secondary, it is a universal, or blood and tissue malady; and finally, in the tertiary, it is a disease of tissues but not of blood, and its manifestations are irregular, in most cases absent; and when they occur they are—in a strong, if not an absolute, sense of the words—local only.

We must again, and always, be on our guard against observations possibly made erroneous by the fact that we study syphilis as modified by mercury, not in its spontaneous development.

The conditions just mentioned as some of those which are most frequent in the intermediate stage, are obviously, some of them, the same in name as those which we witness in the secondary period, whilst others are those which might have been expected later on. They are, however, usually different in certain features from their homologues in the other stages. The erythematous ringed eruption, for instance, is never exactly repeated in any other period. The peeling patches in the palms are more superficial, much fewer in number, and slower in development than the psoriasis which sometimes, in the secondary stage, affects the same parts. Everything in this stage is feebler in type, less acute than in the secondary, whilst there is much greater proneness to wide diffusion or multiplicity than in the tertiary.

A few words must here be said respecting certain cases, in which the secondary and tertiary stages are reputed to run into one another, or in which the disease de-

velops itself so rapidly that they are not to be distinguished. Rightly classified, these are, probably, simply cases in which the specific is not successful, and the secondary stage is, therefore, persistent and severe. The disease remains throughout generalised, never assuming the more distinctive local peculiarities of the tertiary stage. We must not count severity of local processes, that is, tendency to suppurate or to ulcerate deeply, as being a peculiarity of any one stage. It may occur at any period if the treatment fails to cure the malady. The treatment, which is almost always successful in these cases, confirms this view as to their nature. If we enable the patient to bear mercury, by sending him to the country or to the seaside, we usually succeed in curing the disease, but the liability to true tertiary symptoms after a long interval will come just as in other cases.

The true tertiary symptoms are those to which a syphilitic patient may become liable five to ten, or even twenty years after his disease, and after, it may be, a long period of good health. We shall find that they are mostly of the nature of gummata, and that they all possess the peculiar feature of tendency to local spreading to which, when it shows itself in the skin, the term *serpiginous* is given. All of them, when they recede, leave a state of sclerotic atrophy, or, in a few instances, of hypertrophy, of the part involved. In almost all we see good reason to believe that, in addition to the syphilitic taint, some localising influence takes an important share in evoking the local changes. If we attempt to enumerate some of the chief, they are the following:—

Chronic and relapsing periostitis, leading to osseous nodes or sclerotic hypertrophy, but if neglected to suppuration and necrosis.

Muscular nodes, or gummata in the substance of muscles, which often, by their absence of inflammation and comparatively slow growth, simulate tumours.

Gummata in viscera, liver, testis, lung, &c., but in progress, as just noted in the case of muscles.

Gummata in fibrous structures, and in cellular tissues. The meninges of the brain and spinal cord, the capsules of joints, and the subcutaneous cellular tissue generally, are the parts most likely to be affected.

Diseases of the skin of a lupoid type, gummatous or tubercular in commencement, serpiginous, and leaving scars.

Diseases of the tongue of a gummatous or simply inflammatory form; in either case leading to sclerosis.

These affections are so much influenced by the habit of smoking, that it is often quite impossible to say how much is due to the one and how much to the other cause. Superficial sclerotic hypertrophy is a not infrequent result; but as regards this condition and several others formerly supposed to be due to syphilis only, it is unquestionable that precisely similar ones may result from smoking only.

Aggressive structural disorders of the ganglionic, conductive, or central parts of the nervous system, leading to such affections as—

Ataxy and its complications.

Ophthalmoplegia externa.

Ophthalmoplegia interna.

General paralysis of the insane.

Amaurosis from optic atrophy, with various complications.

Paralysis of special nerves (the fifth, the facial, &c.).

In most of these there is not, at any stage, evidence of active inflammation, nor is there any proof of deposit or growth which might deserve the name of *gumma*. No doubt, a very chronic and slightly effusive form of inflammation is at first present, but it gives place quickly to atrophic changes. There is every reason to believe that the initial disease is *serpiginous* or locally infectious, for we find it slowly spreading to adjacent parts unless arrested by treatment. Excepting in their early stages, these affections are not usually much influenced by specific treatment.

Conditions implying general tendency to tissue-degeneration, such as amyloid disease.

Chronic inflammations of mucous membranes in certain regions, attended by thickening and ulceration. These occur especially in the rectum and pharynx, mouth, and female genitals (*esthiomène*).

The influence of specifics in the treatment of tertiary affections is variable and uncertain. Sometimes, as in the case of large gummata of the tongue or of muscle, the influence is shown very quickly, and a cure is easy. This, however, is by no means the case in many of the other tertiary affections. Some of them progress steadily in spite of treatment, or relapse very speedily when it is suspended. In many a distinctly beneficial influence is secured, but nothing like a cure can be obtained. Especially is the last statement true concerning many of the affections of the nervous system, which are remotely connected with syphilitic taint. Thus, the

non-success of treatment can by no means be accepted as conclusive in regard to diagnosis.

Many disorders are in association with a distant taint of syphilis, which yet do not respond definitely either to iodide of potassium or mercury. In nearly all cases, however, these remedies do some good, and it may easily be the fact that they are often laid aside just when decided benefit was about to accrue. A careful study of the therapeutics of lupoid affections of the skin, due to syphilis, will probably much help our conceptions of what takes place in parts which are hidden from our view. Syphilitic lupus very often does not get well under iodide of potassium, but vanishes at once when mercury is pushed. Very often, indeed, it gets almost well under one or the other of these drugs, and the patient, satisfied with the result, leaves off treatment before the cure is absolute. If the least portion of lupus-structure be left, from it the process will again spread. On the other hand, if the patch be quite well, and nothing but healthy scar left, then it is very rare to witness any relapse. In proof of the resistance of this malady to specifics, the fact may be adduced that many cases, in spite of treatment under different surgeons, last half a patient's lifetime. We have but to apply this experience of the power of resistance of syphilitic cell-growths in the skin, to the nervous system, and we shall understand why such maladies as ataxy and ophthalmoplegia often prove intractable. Iodide of potassium, given in sufficient doses, is usually very efficient in the cure of tertiary affections of all kinds. In some respects and in some cases it seems even more useful than mercury. In many instances, however, it depresses so much that its use must be abandoned, and in all such mercury usually succeeds. Whenever a case resists the iodide, and whenever it is important to obtain a rapid result, the two should be combined.

The prognosis of tertiary disease depends wholly upon the success or otherwise of our treatment. In their own nature, all affections of this class are progressive, and show no tendency to spontaneous amelioration. Even when much helped by specifics, there is a great risk of relapse. In many cases, however, when once a complete local cure is obtained, no relapse whatever occurs, and the patient will remain well for many years. In former times, before the introduction of the iodide of potassium, and when we knew less as regards the best methods of using mercury, many cases of tertiary disease ended fatally.

It will be understood, from what has been advanced, that the diagnosis of tertiary syphilis is beset with difficulties. In many cases it is very easy, and in many the sources of fallacy are such that they cannot be wholly avoided. As in the earlier stages, we still find the disease playing the part of an imitator. The form of ataxy which occurs to the syphilitic, and which is in part at least due to their former syphilis, is usually closely similar to ataxy when due to other causes. Many cases of syphilitic lupus are exactly like common lupus, and so of most of the other affections. Without here going into any detail as regards the diagnosis of special affections, it may be said in general that suspicion should be aroused whenever a malady is irregular in its development and course. The syphilitic simulations are seldom quite perfect, and they often develop in a more rapid manner than do their prototypes. In all such cases the history must be carefully inquired into, and upon it the diagnosis must in many cases rest.

Treatment.—Many questions of treatment have already been discussed in the preceding pages, but the subject is so important that, at the risk of repetition, it may be well to recapitulate and enlarge upon it. The treatment of syphilis has in recent years almost narrowed itself down to the judicious use of two specifics. When we have constructed sound rules for the administration of the iodide of potassium and of mercury, our task is almost done. In former times, various vegetable specifics enjoyed a certain amount of repute. The discovery of the iodide of potassium, and the assignment of its place as the adjuvant of mercury, has, however, so fully reinforced the latter drug that we now but seldom hear mention of any other remedies. It is, precisely, in the cases in which mercury either fails to cure or definitely disagrees that the iodide is efficient, and few indeed are those which the judicious use of one or the other, or of a combination, will not conduct to a satisfactory conclusion.

Some general rules may be offered for guidance in the employment of these important drugs.

In the early stages of syphilis the iodide of potassium is comparatively powerless, and mercury should be used. Thus, the induration of a primary sore will resist the influence of the former, but melts away at once when mercury is given. So also of the secondary phenomena, all of which, excepting perhaps sore-throat and sores in the

mouth, are best treated by mercury. The later the manifestation, the longer the period since the primary symptoms, the greater the probability that the iodides will prove efficient. Thus, against all forms of tertiary gummata, whether in muscles, in cellular tissue, or in glands, the influence of the iodide is usually shown in the most rapid and definite manner. A lump in the tongue, in the testis, or in a muscle, will often be absorbed under the iodide with a speed not less remarkable than the disappearance of a large primary induration under mercury. Nor does the precise stage of the gumma appear to make much difference, for the specific power of the drug is shown just as clearly against an open ulcer as against a deeply placed infiltration. From this assertion of the efficiency of the iodide against all tertiary symptoms, it must not be assumed that mercury is not useful in them, nor even that, in many such cases, it is not the better of the two. With some, however, it certainly does not agree; a fact which was abundantly proved by the frequent intractability of tertiary syphilis, in the times before the iodide was known.

In forming a comparative estimate of the value of these two drugs, attention must be given not only to the stage of the disease, but to the dose of the remedy and the idiosyncrasy of the patient. The iodide has certainly during the last ten years lost some of the repute which it enjoyed, and mercury has correspondingly gained. This gradual change of opinion has been coincident with the employment of mercury in much smaller doses than formerly, and its combination with tonics. In a great number of patients mercury, if the dose be but small enough, seems itself to act as a tonic, and careful observations have proved that not only does it favour depuration by the glandular system, but that it actually increases the number of red corpuscles in the blood. Everything depends upon the dose. Instances of idiosyncrasy are not very common in the case of mercury; but we do occasionally meet with patients in whom the smallest doses disagree, and, conversely, with others who take very large doses for long periods with but little appreciable effect. With regard to the iodide, idiosyncrasy plays a much more important part. Many persons cannot take ordinary doses without poisonous effects; many more, who can take them, yet experience under their curative influence, as regards the malady, a degree of depression of nerve-tone which causes real distress. Whilst, in the case of mercury, tolerance is seldom much increased by

habit, the reverse is the fact as to the iodide. With the latter, in almost all persons, without regard to idiosyncrasy in the first instance, it is possible, by gradual additions, to obtain at length tolerance for large doses. It is one of those drugs respecting which the curious statement is true, that the dose does not much matter. We often get as good effects from small doses as from large, and the most severe examples of poisoning have usually been from very small ones. The writer has known patients cured in the most definite manner by doses of less than a single grain, and, on the other hand, a patient has taken, on his own prescription, more than an ounce and a half in the day. If a patient has become tolerant and his symptoms do not yield, it is often wise to increase the dose freely; but, as a rule, it may be doubted whether the very largest ones, now or recently in fashion, do anything more than might be effected by much more moderate quantities.

The fear of causing absorption of the *mammæ* or testes by the prolonged use of iodides exercises but little influence on the minds of modern prescribers. Although, however, these results are very infrequent, yet it must be fully recognised that the iodide does often depress the sexual function very definitely whilst it is in use, and possibly in some instances does permanent injury to it. Many persons become low-spirited and miserable whenever they take it.

With many prescribers, and especially in France, the iodides of mercury enjoy much favour. There can be no doubt that they are exceedingly efficient, but they are for the most part more irregular in their action, more liable to gripe and purge or even to salivate unexpectedly, than are most of the uncombined preparations of either of their components. It may also be doubted whether their combined salts are in the least more efficient than the simpler preparations, which have the advantage of less variability in effect. Those who aim at simplicity of prescription may therefore, without any risk of loss to their patients, well be content to learn the details of the use of mercury and the iodide of potassium severally or together, and may venture to pass by their combined salts. It would be most tedious to attempt to describe the modes of use of the latter; and, as their doses, &c., may be found in all prescribers' manuals, further reference to them will be omitted.

Mercury may be used in many different ways, and so efficient is it in all that each

one has its warm advocates. All that is needful is that it shall be got into the blood and brought into contact with the tissues; and any method, which does this without material interference with the patient's health or disturbance of his digestive functions, is satisfactory. Perhaps we ought, in these respects, to give the palm to those methods—inunction and fumigation—which introduce the drug by absorption through the skin. They are certainly less liable to be followed by purging than when it is given by the mouth. Here, however, their advantages probably end. It may well be doubted whether the claim put forward by their respective advocates, that they are more definitely curative, is borne out by facts. On the other hand, it is very easy to give mercury by the mouth in such a manner that it shall not in the least interfere with the stomach, and this method of treatment is in most instances much less inconvenient to the patient. The writer may confess that, after plentiful opportunities for the observation of different methods, he has adopted the practice of keeping the skin methods in reserve for exceptional cases, and under all ordinary circumstances administers the remedy by the mouth. One simple rule appears to be the key to success. It is to give small doses frequently repeated, and never large ones.

Hydrargyrum cum cretâ is, perhaps, the most constant and least variable of all preparations. It may be made into pills of one grain, in combination with one grain of Dover's powder if necessary, and of these the patient may take one every six, four, three, or even two hours, according to circumstances. Usually, one pill four times a day will suffice to clear away a chancre or a secondary eruption as rapidly and as completely as can be wished. In some cases, it may be more convenient to double the dose than to increase the frequency of administration, but the latter, if the patient is willing, is the better plan. If ptyalism should occur with such doses, it will certainly be mild and easily controlled. As a rule, however, all the symptoms of syphilis may be got rid of without any affection of the gums. If such affection should occur, it usually implies the full physiological influence of the drug, and a very rapid subsidence of symptoms may be simultaneously expected.

During a mercurial course, fruit, green vegetables, coffee, all aperients, and for the most part all stimulants, should be forbidden. The patient should carefully wash his teeth and gums twice in the day,

and it will be better that he should not smoke. All irritation of the mouth by smoking increases the risk of mucous patches, and tends to make sores in the throat more difficult to cure. The reason for abstinence from coffee, fruit, &c., is the risk of their causing diarrhoea. A patient, taking the remedy in the form and doses just indicated, may go to business as usual, and is in no particular risk of taking cold. If he is much out in the fresh air, he must expect some delay in the influence of the specific, and be prepared to require larger doses. In like manner, all tonics—quinine, iron, &c.—enable the system to resist mercury, and should be used only when really necessary. If a patient be kept in bed and on rather low diet, he will yield much more quickly to mercurial influence, and ptyalism may be induced, under such conditions, with half the doses required in one who is about in the fresh air.

As regards the production of ptyalism in the treatment of syphilis, we may say that, although often the most rapid disappearance of symptoms takes place when it occurs, it is certainly to be avoided. If it is profuse, and necessitates the suspension of the remedy, the latter should be used again in smaller quantities as soon as the mouth has recovered. Some of the most severe outbreaks that we ever witness occur to those who have been rapidly cured by a short ptyalism in an early stage, and have then left off the remedy. It is especially under such conditions that rupia is prone to occur.

If mercury be given for an indurated chancre in the manner indicated, it may probably require about a month to get rid of all hardness, but the period varies much in different persons, and perhaps also in relation with the stage at which it is commenced. If it is begun before any secondary symptoms have shown themselves, it is very common for them not to appear at all, or, at most, only in the very slightest form. Sores in the throat are the phenomena least frequently omitted. It is, probably, quite the rule for the skin to escape. If, however, at any period within six months the mercury be suspended, then, within a few weeks of the suspension, a rash may show itself. Such rashes, when they occur, however, are always mild, and their mildness seems proportional to the length of time during which the mercury has been administered.

As yet no statistics have been collected which would enable us to speak, with any confidence, as to the relative efficiency of

different methods of treatment in preventing relapses. We do not know, with any certainty, whether those who have been freely salivated are less prone to relapse than those who have taken such small doses that they have never felt their effects in any other way than the disappearance of symptoms. This remark as to relapses of secondary phenomena applies also to tertiary symptoms. We believe, and probably on good grounds, that those who have taken mercury freely and for long periods, in the early stages of the disease, are less liable than others to the subsequent development of tertiary symptoms; but it must be admitted that proof is wanting. With the prevailing unanimity of opinion in reference to mercury, it is very difficult to get cases for observation in which it has been omitted. Syphilis is in its nature so variable, that it is unsafe to assume that what a few cases appear to teach is really the fact. There can be no doubt that very often we meet with severe tertiary symptoms in those who, from the history given, appear to have had very short or irregular treatment in the first instance. Unfortunately, however, there are some cases on the other side which show persistently recurring reminders, and even severe tertiaries, after specific treatment of the most careful and prolonged kind. As a general rule, mercurial cures in the secondary stage stand good, and a large majority of our patients know nothing more of their disease. But there are exceptions, and these probably occur after all the various modes of administration.

If we are allowed to estimate relative efficiency by the rate of disappearance of the phenomena, then it is probably true that the internal use of grey powder in small doses, frequently repeated, is just as useful as either inunction or fumigation.

To the credit of the method by small doses frequently given, it is to be clearly and strongly stated that patients usually improve in health under them. If purgation be avoided, the patient will often enjoy improved appetite and digestion, and may gain in weight and colour. At the end of a six or nine months' course, he may allege that he never was in better health. Those who have before suffered from constipation and liability to headache, may get quite rid of these troubles and may continue permanently free. In women who have suffered from painful menstruation, the mercurial course may prove a complete cure. These clinical facts, which are matters of frequent observation to specialists in syphilis, are so

definite that they are well worthy the attention of the general physician. It is well known that many distinguished therapeutists have become enamoured of mercury for various chronic ailments, such as scrofula and some forms of dyspepsia, as well as for those in which the liver is more especially concerned. Experience in respect to syphilis would go to show that the drug may be used without any fear of loss to general health, if employed in the way suggested. On the other hand, there is no doubt that severe forms of cachexia and debility may be induced by the irregular and excessive administration of this potent drug.

As regards its mode of influence in syphilis, we may reasonably suppose that it is requisite that it should be brought into contact with the cell-elements concerned in the morbid process. Wherever its local application is practicable, we know that it is usually very efficient. Administration through the blood is necessary only when the disease is generalised, as in the secondary stage, or when its manifestations occur in parts which are not accessible. In a general way, it is well to combine local with internal use. For the primary sore, an efficient dressing with the black wash unquestionably expedites the healing and the disappearance of induration, and so also of the secondary eruption, the removal of which is materially helped by the inunction of a mercurial ointment. For this latter purpose, the ammonio-chloride, in the proportion of fifteen grains to the ounce of lard, is very convenient. Its use is especially desirable when the eruption affects the face and hands, and its early removal becomes a matter strongly desired.

The remarks, just made, may fitly introduce more detailed statements as to the efficiency of local treatment, in all cases in which the disease has passed the secondary stage. Very remarkable instances of this are not infrequently seen. Cases, in which the internal use of specifics has been long continued with only very partial benefit, may be cured very quickly by local measures. Not only may they be cured, but the cure may be a permanent one, and thus a very strong argument is afforded in favour of the essentially local character of such phenomena. Respecting all forms of syphilitic phagedæna in the tertiary stage this is well known. Although the administration of the iodides, or even of mercury, is usually very useful, yet by iodoform, or by cauterisation with the acid nitrate of mercury, the cure may be accomplished in a fifth of the time. So also, syphilitic palmar psoriasis

and syphilitic serpiginous diseases of lupoid type are best treated locally. An ointment, containing one drachm of iodoform to the ounce of lard, if liberally used, will often effect an unaided and rapid cure in such cases. To many it is unquestionably more efficient than any of its competitors. In all syphilitic skin-diseases in the tertiary stage, whether ulcers or new-growths, its use, if the patient will permit it, should never be omitted. That it is not necessary to use a specific is, however, fully proved by the efficiency of caustic applications for the same purpose. A single free application of the acid nitrate of mercury may be sufficient to permanently cure a patch of syphilitic lupus, which had resisted much internal treatment. It would appear that the cell-organisms of such growths possess but feeble vitality, although persistently infectious, and are thus easily killed by any caustic. The point is to destroy every portion, for, if the smallest particle be left behind, it will suffice to reproduce the malady. From what we see of the efficiency of specific applications and internal treatment, in the case of serpiginous affections of the skin, it is probably fair to infer as to their power in diseases of internal parts and especially of the nervous system. If in the former we stop short of a complete cure, the morbid process will be relighted, and a relapse will follow; but if the local cure be perfect, then it will probably be permanent. In this way may probably be explained the frequent disappointments in reference to disease in hidden parts. We do not push the treatment far enough.

After what has been just said, it is clearly impossible to lay down any rules as to the duration of an antisymphilitic treatment. It will depend upon the method employed and the effects produced. If the case be one of primary or early secondary syphilis, and the treatment adopted be that by small doses of mercury without ptyalism, a six months' course will probably be sufficient. During the last four of this period, the patient may probably have been quite free from symptoms. Even after this long course, we must be prepared, in a certain number of cases, to see a symmetrical eruption produced within a few weeks after the suspension of the drug. This rash will probably be an erythema of a very mild kind, and will disappear promptly when the remedy is resumed. Unless some symptoms should show themselves, there is probably no good reason for again resorting to specifics. If the patient be married or intending to marry, it may be wise to con-

tinue mercury for a much longer period, with or without brief omissions. Some good authorities advocate short intermittent periods of administration, and no doubt excellent results may be so obtained. On the small dose system, however, there seems but little reason for ever suspending it until it seems wise to wholly desist.

It may be convenient to introduce here a few details as to the different methods of using mercury for the cure of syphilis. The inunction method is one of old repute and still largely used on the Continent. It gives to Aix-la-Chapelle the reputation which brings to it crowds of patients. At this place, where the details are so well understood, it is customary to have the ointment rubbed in by trained attendants. These men occupy from twenty minutes to half an hour at each friction, and use about half a drachm of the strong mercurial ointment. Everything that is done at Aix can be done equally well at the patient's home. All that is necessary is, that he should give himself up to the treatment and observe proper precautions. The ointment should be rubbed into different places on successive days, so as to avoid the production of eczematous irritation. Generally, it is best borne on the sides of the chest and abdomen, but the inner sides of the arms and thighs are also convenient positions. After the rubbing, the patient should put on a flannel gown and go to bed without washing. In the morning a warm bath may be taken. At Aix, a course of rubbing lasts usually one month, the quantity used and the frequency being modified according to the effects produced. It is usual to advise patients to return after a few months for another course, in order to complete the cure. Excellent results are usually obtained in this way, and not infrequently patients are cured, whose symptoms had been very difficult to deal with under other methods. The explanation of these is, however, usually this, that the other methods had never had a fair chance, owing either to the patient's irregularity in their use, or inattention to diet and exposure to cold. It may be alleged for the inunction plan that it is less likely to disagree, by causing colic or purging, than the internal administration, and that it is very certain in its effects. It may, with good reason, be doubted whether it has any other recommendations, and more especially whether the claim put forward that its cures are more permanent than others is well founded.

At several Continental watering-places of repute for the treatment of syphilis,

popular attention is fixed upon the use of warm sulphur baths quite as much as upon the mercurial rubbing. There is no reason, however, to believe that these exercise any share in the cure. See INUNCTION OF MERCURY.

Another endermic method of administration is by the fumigation bath. This plan was perfected by the late Mr. Langston Parker of Birmingham, and has been very successfully employed by Mr. Henry Lee and others. Calomel is the form of mercury now usually employed. It should be specially prepared and of great purity. The patient is made to sit over a lamp upon which the calomel, in quantity of from a scruple to half a drachm, has been placed. The calomel is sublimed by heat in company with watery vapour, and is deposited on the patient's skin. When the process is completed, the patient is made to wrap himself in a flannel gown, and without any washing or drying to go at once to bed.

This method has the same advantages as that by inunction, and is exceedingly efficient. The two share in the disadvantage of being much more troublesome than administration by the mouth, and although less liable to purge, they are at least equally prone to cause unexpected salivation.

Hypodermic injection has come but little into employment in English practice, nor does it appear to increase in favour with those Continental surgeons who at one time thought highly of it. Mr. Astley Bloxam, at the Lock Hospital, employs it largely, and considers it, on the whole, the most efficient and least troublesome of all methods. Inasmuch as the surgeon administers the dose himself, he has the fullest control over its employment. Mr. Bloxam has, in verbal communication with the writer, insisted on the following precautions:—

In order to prevent irritation and abscess, the injection should be made into muscle and not into cellular tissue. The needle should always be washed after the syringe has been charged, so that none of the fluid may touch the skin during introduction. It is sufficient to inject a third of a grain of the bichloride of mercury dissolved in twenty drops of water, once a week. Three such injections, made on consecutive days, will usually salivate freely, thus proving the efficiency of the method. The *gluteus maximus* is the most convenient muscle for the purpose. The solution should always be freshly made when wanted.

Some important memoranda may be offered as to the use of the iodide of potassium and other iodides.

In some cases the iodide of sodium depresses less than the potassium salt, and acts as efficiently. It is a very good practice to combine the three iodides—sodium, potassium, and ammonium—in the same prescription. Whether given singly or in combination, some free ammonia, preferably sal volatile, should always be added. It always increases the efficiency of the iodide salt. It is never well to begin with a large dose of an iodide. Small ones are, ~~in~~ the first instance, just as efficient as larger ones, and it is often a great point to go on increasing them. Doses of two or three grains will often, at first, do as much as those of ten or more. Every week, if the cure is not progressing rapidly, two grains should be added to the dose.

Coryza is the commonest of all symptoms due to the iodide when it disagrees. It may be very profuse at first, but usually lasts only for a short time. In other cases, the patient may suffer from a chronic cold in the head so long as he continues the drug. When this is the case, there is generally definite depression of tone as well, and the surgeon will do wisely to try whether he cannot effect the cure better by small doses of mercury.

The skin-eruptions which may be produced by the iodide are very various in their characters. They are certainly due to idiosyncrasy, and have little or no relation to the dose employed. They usually develop very quickly, and sometimes with great severity after two or three doses. When once an eruption is produced, we seldom witness any tendency to disappearance, so long as the drug is continued. Usually, the eruption becomes aggravated both in amount and character. A form of acne is the commonest type of iodide-eruption, but hæmorrhages, erythemata, and vesicular and bullous eruptions may occur. Now and then we witness the formation of large bossy wheals, which may develop to a very great size. Some of these eruptions may closely resemble, to the inexperienced eye, syphilitic eruptions, and thus the remedy may be further pushed in the hope of curing that which it is itself producing. In such cases, occasionally a fatal event by exhaustion may be brought about. When eruptions occur, either reduction of dose or disuse of the drug is usually definitely indicated.

Most patients bear the iodides best when in vigorous health, and, in the stage in which they are needed (the tertiary), it is generally wise to employ tonics and fresh air freely. Arsenic has reputé as tending

to prevent eruptions, and many persons will bear full doses when enjoying the advantage of sea air, who are much depressed by them under other conditions.

An extempore combination of the bichloride of mercury with the iodide of potassium enjoys a high repute in English practice. In doses of one drachm of the Pharmacopœia solution of the bichloride ($=\frac{1}{16}$ th of a grain), with four or five grains of the iodide, and half a drachm of sal volatile, a very efficient compound is obtained, which seldom disagrees.

It may be well to mention, in relation to special measures of treatment, certain peculiar symptoms and conditions which may need special rules.

Ulcers in the Throat and Sores in the Mouth in the Secondary stage.—Give mercury, use black wash as a gargle, or dust the sores with iodoform. If they prove intractable, touch them lightly with the acid nitrate of mercury or some other caustic. If very painful, it is necessary to consider whether they may not be aggravated by mercury, especially if the latter has been long used. If this appears probable, mercury must be disused, and the iodide of potassium given. Smoking must always be prohibited.

Ulcers in the Throat in the Intermediate or Tertiary stages.—These are often phagedenic. Iodide of potassium must be freely given, and iodoform applied by insufflation, or by means of a camel's-hair pencil. If, in exceptional cases, the condition persists, the sore must be freely touched with the acid nitrate of mercury. It is a rapidly destructive condition, and the treatment must be efficient. There is usually no objection to small doses of mercury, but the iodide will generally suffice.

Iritis, Retinitis, Neuritis, &c., in Secondary stage.—Push mercury rapidly to slight ptyalism, and in iritis use atropine very freely. Large doses of iodide of potassium will usually suffice for these affections, but mercury is better.

Ulcerating Secondary Eruptions of the Rupial type.—These usually occur after mercury has been given in too large doses, has disagreed, and been wholly laid aside for some time. Mercury, in combination with the iodide of potassium, is indicated, or mercury may be given alone. The iodide alone is rarely sufficient. Ptyalism is to be carefully avoided, and, if success is not soon obtained by other methods, inunction or fumigation should be resorted to. Sea air is often very valuable. When

once the cure sets in, it usually progresses well, and is in the end complete. Iodoform ointment should be used to all sores.

Phagedæna in all forms and stages.—Iodoform is by far the most convenient, least painful, and most efficient agent. It will probably supersede all the older methods. Should it not succeed, constant immersion, the acid nitrate of mercury, or the actual cautery, may be employed. Mercury and the iodide should be given with opium. If all fail, the patient must be at once sent to the seaside, and the same remedies used there.

Disease of Arteries (indicated by Cerebral Attacks).—A long course of small doses of mercury or, less efficient, of the iodide.

Periostitis and all forms of Bone-affection.—Here the iodide of potassium is most efficient, and relieves pain more quickly than anything else. If the case resists, however, mercury should be used, and it will often succeed in removing hard nodes which the iodide had failed to influence.

Periostitis and Bone-affections in the Inherited Disease.—The same remedies must be used, but much less rapid results are to be expected. Very often nodes in this connection resist treatment for some time, and then suddenly disappear.

Lupoid Affections of Skin in Tertiary stage.—Rub in iodoform ointment, and apply it on lint; or, if the part be one to which this cannot be conveniently used, or the smell be an objection, apply the acid nitrate of mercury freely. Iodide of potassium may be given, but, if not successful, it should at once be substituted by mercury, which often succeeds when the iodide fails.

Phagedænic Lupus of Nose and Face from Inherited Syphilis.—The destruction may be very rapid, and the treatment must be prompt. Cauterise freely with acid nitrate, and then dress with iodoform ointment. Give iodide and bark.

Interstitial Keratitis of Inherited Syphilis.—Give a long course of small doses of mercury with bark. Send patient to sea or country during the treatment. Use atropine or belladonna fomentations.

Locomotor Ataxy or other Chronic and Aggressive Nerve-disease with Syphilitic Antecedents.—Give mercury in small doses to slight ptyalism. If benefit results, repeat the treatment after a month's interval, or give smaller doses without ptyalism over a period of six months or a year. Many such cases relapse, and need a repetition of treatment. Inunction is very useful, but

not more so than small doses by the stomach. Iodide of potassium is also very efficient, but probably less so than mercury.

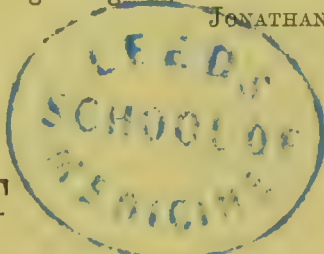
In cases which resist mercury, and in which it is wished to induce ptyalism rapidly, use the hypodermic method, employing a third of a grain every day for three or four days. Or use mercury by the mouth or inunction, or insist that the patient shall keep his bed.

In cases of pregnancy in which it is desired to protect the fœtus, administer small doses of mercury (one grain of grey powder, or one drachm of the solution of

bichloride three times a day), through the whole period. There is possibly an objection to this, that it may damage the child's teeth (first set), but upon this point careful observation is necessary.

In cases in which marriage is in prospect, let the patient take small doses of mercury continuously during the whole period before marriage. Abstain from the iodide. However efficient and long-continued the treatment, no one should marry until two full years have passed from the beginning of the disease.

JONATHAN HUTCHINSON.



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TAGLIACOTIAN OPERATION. *See* RHINOPLASTY.

TALIPES. *See* CLUB-FOOT.

TAPPING. *See* PARACENTESIS.

TARSAL BONES, Caries of the.—The frequency of this disease is well known. The persistent way in which it follows on relatively slight injuries—e.g. sprains, slipping on the kerb, blows from a stone, jumping off a wall—may perhaps be accounted for by the delicate cancellous tissue of which the bones so largely consist, their intimate relation with complicated synovial membranes, the comparatively scanty blood-supply to the dorsum of the foot, its frequently lowered temperature, and the want of rest.

The diagnosis of caries will be spoken of when the chief sites of the disease are considered; but it may be stated here that the early recognition of the disease is of the utmost importance, for so long as the caries is limited to one bone, it will be possible to save a very useful foot.

The chief sites of caries of the foot from behind forwards are: (1) Os calcis; (2) ankle-joint; (3) astragalus; (4) scaphoid, and along with this, on account of the complicated synovial membrane in the middle of the foot, other bones—e.g. cuneiform, astragalus, and the bases of the metatarsal bones—are too often affected; (5) cuboid.

OS CALCIS.—It is important to remember that caries remains limited to one bone much longer in some of the above than in others, and in none longer than in some cases of caries of the os calcis. This may be present, originally, in three different

sites: (a) Caries of the body of the bone; (3) caries of the astragalo-calcaneal joint, which may begin as a primary affection after a severe twist or sprain of the ankle, or may be secondary by extension from the body of the os calcis or from the under surface of the astragalus; (γ) caries at the back of the os calcis between the body of the bone and the posterior epiphysis—an epiphysis which does not appear till the tenth year, and which does not unite with the body of the bone until the fifteenth to the nineteenth years.

Diagnosis.—The thickening is limited to the neighbourhood of the heel, where the swelling obliterates the natural sulci on either side; the sinuses are met with chiefly posteriorly, but may form as far forward as the calcaneo-cuboid joint, corresponding then to a point midway between the external malleolus and the base of the fifth metatarsal bone.

It will be pointed out, later on, that in disease of the ankle-joint, astragalus, &c., not uncommonly a probe can be passed across the instep beneath the soft parts, from sinuses on one or both sides. This is not the case with disease of the os calcis, but, in some severe cases of disease of the calcaneo-astragaloid joint, a probe can be passed across the heel through this joint. The movements of the ankle-joint will be found free and painless, an anæsthetic being given to a child if needful. Where calcaneo-astragaloid disease begins primarily, its diagnosis is a matter of more difficulty. The position of the swelling and sinuses may here approximate to those met with in disease of the astragalus or ankle-joint; the pain is

greater than in disease of the body of the os calcis, and the foot is sooner disabled. By the aid of an anæsthetic the ankle-joint will be found free, and probes, introduced by sinuses, may pass towards the upper surface of the os calcis, the level of which is known by its being on a line with the bony projection for the origin of the extensor brevis digitorum. Occasionally, as already stated, a probe may pass across the heel through this joint.

Disease between the epiphysis and body of the bone may be detected, not only by the position of the sinuses and swelling, but also by the age of the patient, and by the fact that, owing to the insertion of the tendo Achillis into this epiphysis, pain will be complained of and impairment of movement noticed, when the patient is asked to throw the tendon into action by raising the heel or rising on to the toes.

Treatment.—The surgeon, in deciding between (a) expectant treatment and (3) operative measures, either partial—e.g. exploring and gouging—or complete removal of the bone, will be led by the following considerations. If the patient is in fair health, if the viscera (especially the lungs) are sound, if the patient is in a fitting position to secure unbroken rest, constant attention, good food and air; if no sinuses have formed, or if the sinus be single and healthy-looking, if the origin of the disease be distinctly traumatic, then, under the above circumstances, expectant treatment is fully justified. But if, on the other hand, the subject of the disease be ‘etiolated,’ have been subject from infancy upwards to bad air, food, poor hygiene of every kind, if from the rank of life it is important to save time for schooling, apprenticeship, &c., then operative measures without further delay are as clearly indicated. These do not necessarily mean removal of the whole bone, an operation which, while it leaves a very useful foot, leaves also a very ugly one. In any case, the condition of the bone is best explored from its outer side, which has few important structures in relation to it.

An anæsthetic being given and the parts rendered bloodless by Esmarch's bandages, incisions are made which are modifications of those for removal of the entire bone. Thus, by making on the outer surface of the os calcis, on a level with its upper surface, a horizontal incision commencing at a point midway between the external malleolus and the base of the fifth metatarsal bone, and ending just outside the tendo Achillis, joined by a second incision at right angles to the anterior extremity of the first, as far as

the sole but not encroaching upon it, a sufficient flap can be turned down for exploration of the bone. Now, if steel probes passed into any sinuses which may exist do not pass far into the bone, if the bone around them is hard, not soft, fragile, and ready to break down, and if the probes do not pass towards the calcaneo-astragaloid joint, the surgeon may be content with thoroughly gouging out the sinus and removing all carious bone or pulpy granulation-tissue. The softer the bone the more carefully must any gouging be carried out, for fear of setting up secondary inflammation, which will itself pass on into caries.

The cavity should then be firmly plugged with strips of gauze soaked in carbolic oil or the next best antiseptic dressing at command, the Esmarch's bandage removed, any bleeding points secured, and the parts brought together with a few points of suture. After one or two dressings, the strips may be replaced by a drainage-tube, which should be gradually shortened. When the cavity has filled up from the bottom, and the parts are healed, the patient should go about for six or eight weeks with a crutch, or a stick and a knee-rest.

If, on the other hand, the bone around the sinus is soft and friable, if the probes enter far, especially if they run towards the calcaneo-astragaloid joints, it will be wiser to remove the whole bone at once by prolonging the above incisions—the first farther inwards through the tendo Achillis, and the second farther into the sole. *See Os Calcis, Excision of the.*

If the disease of the bone has arisen in the calcaneo-astragaloid joint, and palliative treatment has failed, the surgeon has the choice of trying to eradicate the disease by getting at it, from above, by removal of the astragalus—an operation which will necessitate division of the anterior tendons, but which has the advantage of being readily converted into a Syme's amputation either at once or later on; or, by attacking it from below by removal of the os calcis, and then removing the articular surface of the astragalus with a chisel, and then getting completely rid of any pulpy disease or carious bone in the neighbourhood with the gouge, &c. This method only severs the tendo Achillis, which will take on a fresh attachment in the fibrous tissue and cicatrix, and leaves better drainage than the other; but it has this disadvantage, that it will hamper the operator if he finds it better to convert his excision into a Syme's amputation.

CARIES OF THE ASTRAGALUS AND ANKLE-JOINT may be spoken of under one heading.

Diagnosis.—In both these affections the swelling is situated more anteriorly than in the preceding; the bulbous look and clubbing of the foot are more marked; if sinuses are present, probes will often pass right across the front of the foot beneath the soft parts, or, by aid of an anæsthetic, into cavities in the astragalus or across exposed bone on the non-articular part of the bone, when it alone is involved, or into the ankle-joint itself.

The ankle-joint may be found to be involved when the parts are examined with an anæsthetic, but, even if ulceration of cartilage be present, grating will not necessarily be obtained, as the intervention of pulpy tissue will often prevent the articular surfaces being brought into contact.

While the above points, together with the duration of the case, the number and direction of the sinuses, and the amount of crippling will aid in determining between the two diseases, it is often quite impossible to tell, till the parts are explored by operation, whether disease of the astragalus has involved the ankle-joint or not.

Treatment.—If palliative treatment has failed, or if the time for this has gone by, the question of excision of the diseased bone or of amputation of the foot must be faced. In deciding for or against the more conservative operation, the surgeon will be influenced by the considerations already spoken of with regard to the os calcis.

If it be decided to perform excision, the writer is convinced that in most cases of adults, and in all of children, this operation is best performed by a transverse incision, as no other sufficiently exposes the bones concerned and the limits of the disease, and as this readily admits of a Syme's amputation being performed now or later on. An anæsthetic being given and Esmarch's bandage applied, the soft parts are divided by an incision across the joint and going down to the tendons. These may be readily united, when the operation is completed, by passing silk through three or four of them above and below the points where they will be divided. The tendons are then severed, the sutures held out of the way, and the joint opened. The articular surfaces of the tibia and malleoli and the trochlear surface of the astragalus having been sawn off, any extension of the disease to the inferior tibio-fibular, the astragalocalcanean, or astragaloscaphoid joints should be examined into, and any suspicious patches of bone or altered synovial

membrane removed with gouge, chisel, or sharp spoon. The anterior tibial and any other arteries should then be secured, the tendons stitched together, and the wound closed with a few points of suture, a drainage-tube having been passed from side to side.

The writer is strongly of opinion that in the majority of cases the above method will be found not only easier, but superior to that by lateral excisions along the lower ends of tibia and fibula. See JOINTS, Excision of.

Two points of advantage—the complete exposure of the parts and the possibility of readily converting it into Syme's amputation—have already been spoken of; as to the disadvantage of severing the tendons, it is to be remembered that, if reunion does not take place, the free examination of the disease secured is a great set-off, and that free mobility is not a point of such primary importance in the foot as a firm, sound basis of support.

Excision of the astragalus may be performed in the same way. The bone being exposed by freely opening the joint, the ligamentous structures are then divided by a careful use of the knife, especially at the posterior part, and the bone turned out by aid of the lion-forceps and elevator. The articular and synovial structures in the vicinity should then be carefully examined, and treated, if necessary, as directed above.

Where the articular bed, out of which the bone has been lifted, shows patches of caries, or pulpy, pink, grey masses, while the astragalus is soft and fatty, easily crushing down in the lion-forceps, the recovery will not be permanent. Owing to the facility with which disease of the astragalus extends into the ankle, to the scaphoid, and the large mediotarsal synovial sac, excision of the astragalus alone will not often be called for. But, if the writer's experience be correct, there is a small class of cases, met with in children, where there is necrosis of the astragalus, a sequestrum in it, or limited caries of the non-articular part of its dorsal surface. In these cases, especially where the mischief is recent and traumatic, the prognosis is much better after removal of the bone.

DISEASE OF SCAPHOID AND MEDIOTARSAL JOINT.—Disease of the scaphoid by itself is not very common; far more frequently by contiguity of synovial membrane other bones are involved, especially the cuneiform and astragalus, by means of the large and complicated synovial membrane which is common to these and other bones.

Diagnosis.—In such a case, the most marked part of the characteristic bulbous swelling will be found more anteriorly in the foot than when the astragalus and ankle-joint are affected. This is also the case with the sinuses, and, by aid of an anæsthetic, steel probes will probably pass into the mediotarsal bones and joints, movements of the ankle-joint will be free, and grating may be obtained by lateral twisting of the centre of the foot.

Treatment.—Of all the sites of caries of the tarsus, this, on account of the number of bones which may become involved, and the difficulty of complete eradication, is one of the most important. If the disease is clearly extending, operative steps are called for early, and the surgeon has to choose between (a) attempting to remove all the diseased bone, (β) Chopart's amputation, and (γ) amputation at the ankle by the method of Syme or Pirogoff.

If the general and local conditions seem favourable to attempting to get all the disease away, one of the two following methods may be attempted. Free exposure of the parts by means of a flap adapted to the case, but made, if possible, mainly from the outer side, any tendons that admit of it being drawn aside, but others, where needful, being severed. The diseased bones and pulpy material being next thoroughly removed, sinuses freely laid open or scraped with a sharp spoon, and the synovial membranes along the tendinous sheaths on the dorsum examined if there be any suspicions of disease, the parts are brought together by a few points of suture, drainage being provided for.

The other method of trying to secure removal of all the disease, by going through sound parts in a case of extensive mediotarsal caries, is that practised by Dr. P. H. Watson of Edinburgh. Thus, when the disease is situated between the bases of the metatarsal bones in front and the astragalus and os calcis behind, lateral incisions three to four inches long are made from the centre of the os calcis to the middle of the fifth metatarsal bone, and from the neck of the astragalus to the middle of the first metatarsal bone, and the soft parts are then carefully dissected from the plantar and dorsal aspects of the foot through these incisions, the left thumb being kept between the point of the knife and the bones. The astragalo-scapoid and calcaneo-cuboid joints are then opened up with a curved probe-pointed bistoury, and a keyhole saw passed between the plantar soft parts and the shafts of the metatarsal bones, and these

are cut through from below upwards. The bones being removed, the wound is firmly plugged and pressure applied with pads and bandages before the Esmarch's bandage is removed. The first dressing is kept on for forty-eight hours, its object being to prevent hæmorrhage. That this operation is an excellent one in Dr. Watson's hands is shown by five out of his six cases doing well. The objections seem to be that it is done somewhat in the dark, and that, from the amount of bone which has to be removed by limited incisions, a good deal of damage may be done to soft parts unless great care is taken. But at the present time, with the advantage of antiseptic treatment, and the thorough plugging of such a wound which this allows, it will be well worth while to make use of the above method in favourable cases or where amputation is refused. The foot will of course be kept well raised, and morphia given freely if required after the operation.

(β) *Chopart's Amputation.*—Where the surgeon finds it inadvisable to attempt excision, when the astragalus and os calcis are really sound, he may, if urged to leave as much of the foot as possible, make use of the above amputation. But it should always be explained to the patient, especially when the disease has been of a carious nature, that he may pay a heavy penalty for the preservation of part of his foot in the shape of recurrence of the disease in two or more years' time. If the amputation be performed, the chief anterior tendons should always be stitched firmly into the plantar flap to counterbalance the tendo Achillis, otherwise tilting of the heel, fretting of the scar, and protrusion of the astragalus, the banes of this operation, are very likely to follow.

(γ) *Syme's and Pirogoff's Amputations.*—While the latter, when successful, leaves no doubt a firmer, longer stump, while it is accompanied by much less wasting of the calf-muscles, so that the power of quick flexion of the knee, as in rapid walking, &c., is much better performed, on the other hand, the result of a Syme, though inferior in the above points, is still so excellent and useful that it seems scarcely worth while to run the risks of recurrence of the disease and non-union of the cut bones, risks which are undoubtedly present where Pirogoff's amputation is performed in cases of disease. Where the bones, though externally healthy, are found soft and fatty on section, or where the patient is much pulled down with suffering or advanced in years,

Syme's amputation is certainly to be preferred.

CARIES OF THE CUBOID.—Not very common, probably owing to the earlier ossification of outer side of foot. When present, may be associated with disease of fourth and fifth metatarsal bones. Excision should be resorted to with hope of good results.

CARIES OF THE METATARSAL BONES. This is not at all uncommon in children; in adults it is also met with chiefly as caries of the first metatarsal bone, when attacking one bone only, or of the middle metatarsal bones when occurring in combination with disease of the mediotarsal joints. Any of these bones, if alone diseased, may be readily and successfully extirpated by a longitudinal incision over their dorsal surface, with small incisions at right angles to this at either extremity, if need be. The soft parts are to be carefully separated either by the point of the knife, kept close to the bone, or by a blunt director; the head of the bone is to be detached first and well raised, and the base then turned out, especial care being taken at this point to avoid the plantar arch. The cartilages of the cuneiforms or the phalanges should be carefully examined, one or two points of sutures applied, and drainage provided for, if need be, by puncturing the sole on the point of dressing-forceps and passing through a drainage-tube or 'drain.' The sesamoid bones of the great toe should always be left if possible. It will be found that the toes sink considerably towards the tarsus, but the foot is, subsequently, a very useful one. The writer considers the above method of removal by a single incision much superior to that (recommended for the great toe) by a single flap from the inner side or by oval flaps, as it entails less interference with soft parts, and as the resulting scar is more entirely out of pressure. The treatment of that form of caries and necrosis of the metatarsal bones which is met with in **PERFORATING ULCER** has been described elsewhere. Caries of the metatarso-phalangeal joint of the great toe has been treated of under **BUNION**.

W. H. A. JACOBSON.

TARSAL CARTILAGES, Affections of the. See **EYELIDS**, Diseases of the.

TARSAL JOINTS, Diseases of the.—Acute inflammation of the tarsal joints is usually the result of injury, or is of pyæmic origin. The symptoms are pain, heat, and swelling over the affected joints. The pain is acute, and much increased by movement or the attempt to bear any weight on the

foot. The swelling is most manifest on the dorsum of the foot.

For *treatment* the leg must be placed upon a splint with a foot-piece, and leeches or cold applied. In the acute inflammation following a sprain, much relief is obtained by the early application of leeches. In the pyæmic or other forms in which suppuration occurs, matter must be evacuated and long rest maintained, for ankylosis of these joints may leave a very useful foot.

Chronic disease of the tarsal joints is commonly of scrofulous origin. It may begin in a single joint, as that between the calcaneum and astragalus; or in a single bone, making its way thence into the adjacent joint; or, as is more commonly the case, in the synovial membrane common to several of the joints.

Here, the early treatment of the case need not necessitate the disuse of the limb. A moulded leather splint will keep the tarsal joints at rest, while the patient rests the bent knee on a peg-leg. The health should be carefully looked after, and counter-irritation by the cautery or small blisters be used from time to time. If suppuration occurs, and caries of the joint surfaces is suspected, or ascertained by crepitus on movement, an examination should be made of the foot during anæsthesia. The limitation of the disease will thus be more clearly defined; and if it is found to be confined to one joint, the thickened synovial membrane should be scraped away, and ankylosis aimed at. Not infrequently the disease, having started in one of the bones, is limited to the joints connected with that bone, in which case the most satisfactory results may be obtained by an excision of the bone and the removal of the diseased synovial membrane. If, however, a large number of the bones or joints of the tarsus are affected, and the disease is progressive, amputation either of the whole or part of the foot will be indicated. See **TARSAL BONES**, Caries of the.

J. WARRINGTON HAWARD.

TAXIS, the, is the attempt to reduce a hernia by manipulation. It is performed by placing the patient in the recumbent position and then exerting a gentle, steady, and kneading pressure on the protrusion. The direction of the pressure must be in the direction of the hernia and towards the mouth of the sac; thus, in inguinal hernia the pressure should be upwards and outwards; in femoral hernia downwards, backwards, and then upwards and inwards; and in umbilical hernia directly backwards.

Taxis, if performed gently, is usually unattended with danger, but much knowledge and care are needed to ascertain the condition of the contents of the sac.

In the non-strangulated condition of hernia, taxis may be used for a quarter of an hour, but the patient must be carefully watched during the attempt at reduction; if the protrusion be intestine, taxis rarely accomplishes much after ten minutes; but in simple epiplocele the taxis may be kept up for a much longer time, if a sensible impression is made on its size.

In enterocoele, the taxis should consist of uniform steady pressure, so as to empty the intestine of its gaseous and fluid contents, after which the gut is easily reduced; if the protrusion is an epiplocele, the taxis must be that of a kneading character, when the omentum is gradually replaced. In the latter case much pain is often referred to the epigastric region during the taxis, which may even be succeeded by faintness and vomiting.

While attempts at reduction are being made, the sac should be kept well pushed down by the fingers of the left hand, so that it is steadied and made as tense as possible while the hernia is being reduced by the other hand. This plan enables the hernia to be more easily reduced, while the liability to *réduction en bloc* is correspondingly lessened. When the hernia is large, it must be grasped by both hands.

The success of the taxis will be materially influenced by placing the parts in such a position as will render tense the fibrous margins of the rings. The position of the thigh recommended by most surgeons, prior to the attempt at reduction, is that of semi-flexion, adduction, and rotation inwards, the effect being to slacken the margins of the rings. The writer believes that in inguinal hernia the best position for reduction is that of simple extension of the thigh, and in femoral hernia that of abduction and rotation outwards of the thigh, thus rendering the apertures tense, so that they are not pushed in front of the protrusion when taxis is employed.

Occasionally, though very rarely, ill-effects have followed the taxis, it having been succeeded by peritonitis, and even by hæmorrhage from the bowels.

It is impossible to lay down definite rules as to the length of time taxis may be, with safety, employed in strangulated hernia. This must largely depend upon the experience of the surgeon, the condition and the previous treatment of the patient, the nature and the probable condition of the

contents of the sac, and the anatomical relations of the hernia. If seen for the first time, the taxis should not be used for longer than ten minutes, and even then only gently, for more harm is likely to accrue from violent attempts at reduction than from herniotomy. Reduction may sometimes be facilitated by passing the tip of the finger into the inguinal, crural, or umbilical rings, so as to stretch them. A hot bath is frequently a valuable adjunct to the taxis in cases of strangulated inguinal hernia, but it seems to be of little use in those of the femoral variety. The administration of an anæsthetic is often of great use in the taxis.

Attempts at taxis should not be employed in cases in which there is evidence of sphacelus of the intestine, in those where there is much collapse of the patient, in those in which there is much abdominal pain, or in those in which the skin presents a dusky brown and œdematous appearance, indicative as this frequently is of gangrene of the intestine or the sac. Length of time of strangulation must influence efforts at reduction, and it is well not to attempt the taxis when an inguinal hernia has been strangulated more than four days, and a femoral more than three days. Apart from the danger of returning injured intestine, there is the great risk of returning highly septic fluid from the sac into the general peritoneal cavity. See HERNIA, Strangulated.

JOHN LANGTON.

TAYLOR'S SPLINT for the hip is composed of a metal bar long enough to reach along the outer side of the limb from the pelvis to the sole of the foot; it is provided with hinge-joints opposite the hip and knee, and the lower end of it is formed of two pieces, one of which slides within the other and is capable of being fixed at the requisite length by means of a ratchet. At the upper end of the bar there is a stout and well-padded metal pelvic girdle, which carries buckles to support a perineal band. There is another padded metal band attached to the middle of the thigh-piece, and a third band of soft leather fixed on to the leg-piece just below the joint for the knee. At the lower end of the splint there is a transverse bar, which may either be fixed to the sole of the boot or to a foot-piece. By turning a key, the splint may be lengthened or shortened as required. To apply the splint, the pelvic girdle and perineal band should be adjusted, and the foot should be fixed either to the foot-piece or into the boot, and then, by a turn of the key, the splint may be lengthened until the limb is

securely fixed. Finally, the bands for the thigh and leg should be buckled in position.

BILTON POLLARD.

TEALE'S AMPUTATION. *See* AMPUTATIONS.

TEETH AS A TEST OF AGE.—
TEMPORARY TEETH.—The lower central incisors are erupted at the age of from six to nine months, the four upper incisors at ten months; the lower laterals and four first molars a few months later: then—after a rest of four or five months—the canines, and lastly the second molars; the whole being in place by the completion of the second year. But these dates are subject to variations, even in perfectly healthy children, and are of course much delayed by feeble health, and especially by rickets.

PERMANENT TEETH.—About the sixth or seventh year, the first molars come up, next the lower central incisors, then the upper central incisors, and a little later the laterals, this bringing us to about the eighth year. The first bicuspid appears in the ninth or tenth year, then the second bicuspid, and the canines about the eleventh year, the lower having often considerably preceded the upper. The so-called twelve-year molar is more generally a year later than its name implies, and the wisdom teeth are exceedingly uncertain, ranging from the eighteenth to the twenty-fifth year, or any later period.

When the teeth are all in place, a careful inspection of their working surfaces will reveal a varying amount of wear in young subjects, the teeth first cut having had a good many years of additional attrition; but, owing to the very various densities of teeth, too much stress must not be laid upon the absolute amount of wear, which will also be greatly influenced by the accuracy of the articulation of the upper and lower teeth.

CHARLES TOMES.

TELANGEIECTASIS. *See* NÆVUS.

TEMPERATURE.—Departure from the normal temperature of the body is so frequent and so important a sign of disease, that an accurate knowledge of the chief facts concerning the temperature in health is essential.

Source of Bodily Heat.—The body loses energy in two ways, in the shape of heat and in the performance of mechanical work. This energy is derived directly or indirectly from the food. Food consists for the most part of complex organic compounds, the molecules of which are held together by a

large amount of potential energy. The whole of this force is set free when the molecules are broken up into their elements, and it makes no difference whether the disintegration is effected by one or many steps, or even if the downward course is now and again interrupted by synthetical processes, in which force is rendered latent.

When food-stuffs are burnt they set free large amounts of force, which have been carefully measured and expressed as units of heat or units of work. The amount of force set free by the combustion of any food-stuff is spoken of as its *heat-value*. Now, starches and fats are completely burnt in the body and yield up to it their full heat value; but proteids are reduced only to urea, so that it is necessary in their case to subtract the heat-value of urea from that of albumen, to obtain the amount of force they give up to the body.

When the body-weight is stationary, the daily discharge of carbon, hydrogen, and nitrogen will exactly equal the quantity of these elements taken in as food. Still, the food is not directly burnt by combination with oxygen in the blood, but is probably all assimilated by the tissues to repair waste, whilst worn-out portions of the latter unite with oxygen and are removed from the system. Combustion of the tissues is, therefore, the direct source of heat: all are being consumed and all yield energy. But destructive chemical changes go on much more rapidly in some tissues than in others, and two—muscle and gland—stand out prominently; of these, muscle must, on account of its great bulk, be regarded as the chief source of heat. Of the energy set free at each muscular contraction some disappears in doing work; the rest, never less than three-fourths, and often much more, appears as heat. When not contracting, muscle, like non-working tissues, is slowly burnt.

Heat may be derived, also, from sources external to the body—e.g. fire, hot bath, hot food—which affect it by radiation or conduction; also by transformation of other forms of energy, especially motion. Thus, much of the force with which the blood leaves the heart appears as heat.

Without some means of distributing the heat developed so excessively in muscle and gland, these tissues, or parts contiguous to them, would be very hot, whilst parts consisting of skin, tendon, and bone would be very cold. The circulation of the blood is the means by which the temperature of the different parts is rendered tolerably

uniform; it cannot be strictly compared to a hot-water heating apparatus, for the blood is not warmed at one furnace, but receives more or less heat from every tissue through which it passes. In some parts—e.g. the limbs, and superficial parts generally—it loses more heat than it gains; whilst in the central portion of the trunk it gains more than it loses, the blood in the hepatic vein being the hottest in the body. The more rapid the circulation in a part, the less the heat lost by a given quantity of blood in its passage through it; consequently, the temperature of a superficial part becomes more and more equal to that of the viscera as the rate of blood-flow through it rises, but sinks rapidly under opposite conditions.

Under such circumstances the temperature of the body cannot be the same everywhere; the more peripheral parts must be colder than the more central. Consistently with health the surface temperature may vary greatly; but that of the internal parts remains remarkably constant, even under conditions of great external heat and cold. This maintenance of the exact balance between the production and loss of heat indicates the existence of a very sensitive regulating apparatus, which may act either upon the loss or production.

Heat is lost by radiation and conduction from the surface of the skin, by evaporation from the skin and pulmonary mucous membrane, by warming air and other ingesta. It is easy to see how loss of heat, through these channels, may be increased or diminished as depression or elevation of the body temperature may require. With regard to the lungs, the larger the quantity of cool, dry air inhaled, the greater the loss of heat. We cannot make much use of this therapeutically, but in fever and during exercise respiration is naturally quickened. Much more heat is lost from the *skin*, and this loss is greater the more rapid the blood-flow through the skin. Dilatation of the skin-vessels, such as occurs during strong exercise, therefore tends to keep down the temperature. As a rule, dilatation of the cutaneous vessels is accompanied by increased secretion of sweat, but not always. The secretion of sweat-glands seems to depend upon stimulation of their secretory nerves, just as that of the submaxillary depends upon excitation of the chorda tympani, without which no congestion of the gland will produce secretion. So rapidly is heat lost from a freely sweating skin, that, if circumstances favour evaporation, little or no rise of temperature will be found in a person exposed to air at 100° C. (148° F.)

On the other hand, contraction of the skin-vessels diminishes loss of heat greatly; it is induced by external cold.

Next, there are many facts which show that the *production of heat* also varies, and takes its share in the regulation of temperature. Perhaps the most conclusive is the increased absorption of oxygen and discharge of carbonic acid upon simple exposure to cold, proving that increased combustion of tissue is going on; as occurs also in fever. From these and other facts it is believed that there is a centre above the medulla oblongata, possibly in the pons, which regulates the temperature of the body, being in close connection with the vasomotor centre and having control over the metabolism of some, if not of all, the tissues.

An absolute *normal temperature* of man cannot be spoken of, for the temperature varies in different parts of the body; and even in central parts, where it is most constant, undergoes certain daily variations. Nor are the limits of these variations the same in all healthy individuals. A temperature which would be normal in one part at a certain time of day, would be abnormal in another part at the same time; and the normal temperature of a part in one person, might be abnormal for another person. The term 'normal temperature' is somewhat loosely used to express a temperature falling within the limits experience has fixed as the extremes, beyond which the temperature does not pass in health.

Diurnal Variations.—The rectal temperature in most healthy adults reaches a minimum of about 97°·5 F. (36°·5 C.) between 5 and 6 A.M. It rises somewhat rapidly up to 10 or 11 A.M., and then more slowly to 5 or 6 P.M., when it reaches a maximum of 99°·5 F. (37°·5 C.) After 8 P.M. it slowly falls. The total range is generally less than 2° F., in many people considerably less. The maximum and minimum are not attained at the same time in all people. Ordinarily, the temperature pursues the same course, whether the individual is sleeping or waking; but it is said that prolonged working at night and sleeping in the day will transpose the times of occurrence of the maximum and minimum.

Sex has no influence upon temperature; normal menstruation has no effect.

Age.—The new-born child is slightly warmer than the uterus of the mother, and for some days the average temperature is high. The diurnal variation in a baby is greater (3° F.) and less regular than in an adult. Up to puberty there is a slow loss of 0·4° F. on the average daily temperature;

and as much again is lost up to fifty. After sixty the average rises, and at eighty equals that of a baby. This rise is certainly not due to more active nutritive exchange, but perhaps is accounted for by the anæmic dry skin of old age.

Food.—It is said that during the solution of solid food a slight fall of rectal temperature occurs; all agree that during absorption there is a slight rise. Taken during the natural daily rise, food may temporarily increase it 0.5° F.; but it will not do more than delay the natural fall. Simple hot drinks cause a passing elevation, but, by increasing the cutaneous circulation, they render the loss of heat greater. Alcohol lowers the temperature, perhaps in a similar way. Strong coffee causes a rise of 0.4 to 0.7° F., reaching a maximum in an hour; tea has a weaker effect.

Exercise.—*Muscular action* raises the temperature; this is seen in infants after crying, between the pains of labour, in tetanus, and severe exercise. Rest lowers the surface temperature, a difference being noted even between lying and standing.

The Thermometer.—A mercurial instrument, maximum registering, to do away with the difficulty of reading *in situ*, is used. Besides being accurate, a clinical thermometer should be sensitive and quick-acting. *Sensitiveness* varies with the length of the degree; the larger the bulb and the finer the bore of the tube, the longer the degree. The bulb cannot be very large, as size would interfere with its introduction; the largest size and fullest contact with surrounding parts are obtained by making it cylindrical. *Quickness of action* is given by a small bulb of thin glass, and of such shape that the mercury exposes a wide surface to the tissues. Quickness of action may be increased by warming the bulb before insertion *almost* to the temperature of the patient. Sensitiveness and quickness of action therefore require somewhat different makes of thermometer; the mean must be struck, and strength for practical purposes must not be left out of account. Thermometers are best made without any external constriction between the bulb and stem. For clinical purposes, a degree clearly divided into tenths or even into fifths is sufficient; and only that portion of the scale lying between 95° and 110° is ordinarily required.

In taking a temperature it is necessary:

1. To be sure that no local influence—e.g. unusual exposure, passage of cold air, or of hot or cold fluids over it—has affected the temperature of the part selected.

2. To secure the most complete contact of the bulb with surrounding parts; for perfect accuracy the column of mercury should not be exposed.

3. To allow ample time for the mercury throughout to obtain the temperature of the cavity.

4. To read the thermometer with the axis of the eye vertically over the point of the index.

5. If the result is unexpected, to repeat the observation with extra caution and with a well-known instrument.

Temperatures are usually taken in the axilla or mouth; less often in the rectum (always in children) or vagina. Of these, the rectum is certainly the best; for it represents much more nearly than mouth or axilla the temperature of internal organs, and is much less exposed to disturbing local influences. Even its temperature is some tenths cooler near the anus than two to three inches up; the thermometer should therefore be passed well up the bowel. Ordinarily the axilla is $.5^{\circ}$ to 1° cooler than the rectum; but in old people in health the difference may be as much as 3° (Charcot). Further, the temperature of the axilla continues to rise slowly for at least twenty minutes after it is converted into a closed cavity, by laying the arm across the chest.

The temperature of a limb can generally be taken by placing a thermometer in the fold of the flexed elbow or knee, and thus surrounding it. But it is difficult to obtain measurements of the temperatures of flat surfaces, as the scalp. Surface thermometers are generally made with long bulbs coiled at right angles to the stems, so that one side lies in close contact with the surface, the other being closely surrounded by wood, vulcanite, enclosed air, or some good non-conductor. Two thermometers should be used, a comparative observation on the opposite side being made. Half an hour's contact is generally necessary.

STANLEY BOYD.

TEMPORAL ARTERY, The, is one of the terminal branches of the external carotid; it commences opposite the neck of the condyle of the lower jaw, it ascends over the zygoma immediately in front of and above the tragus, and finally ends, on a level with the highest point of the ear, by dividing into anterior and posterior superficial temporals.

LIGATION.—The trunk of the artery is reached by an incision commencing over the zygoma just above and in front of the tragus, and carried vertically upwards for

the distance of one inch. Cut through the cutaneous structures, but raise the deeper tissues upon a director. Pass the needle from behind in order to avoid the vein and the auriculo-temporal nerve, which accompany the artery. The *anterior* temporal pursues a wavy course along the limit of the hair in front of the temple; the *posterior* temporal continues the vertical direction of the main trunk towards the top of the head. Either vessel may be secured at, or immediately below, a bleeding point by ordinary ligature or by acupressure.

JAMES CANTLIE.

TEMPORO-MAXILLARY ARTICULATION, Diseases of the.—Inflammation may lead to complete ankylosis of the joint, and consequent immobility of the jaws. Arthritis occurs as the result of injury or of constitutional affection.

In children it follows the exanthemata, and is often connected with suppuration in the tympanum.

In adults it is of a rheumatic or gouty, and therefore more chronic character. Rheumatoid arthritis also affects the temporo-maxillary articulation, and leads to great suffering, from the painful movement of the jaw. In two patients the writer has noticed the characteristic enlargement of the condyle and neck of the bone, with protrusion of the chin to the opposite side, described by Robert Adams in his great work on the subject. This disease does not, however, lead to the osseous ankylosis or synostosis, which is met with in cases of common arthritis with suppuration.

Treatment.—In acute inflammation of the joint, leeching and fomentations, with timely evacuation of pus, would be the appropriate treatment. In the more chronic forms, attention to the constitutional diathesis, and the frequent application of blisters over the joint, offer the best chance of relieving the patient, but the treatment is eminently unsatisfactory.

Dr. Goodwillie, of New York, has ingeniously proposed to produce extension between the surfaces of the temporo-maxillary articulation by fitting blocks upon the molar teeth, and then drawing up and fixing the chin, and gives several cases in which a cure was thus brought about.

The ankylosis resulting from articular inflammation may be fibrous or osseous, and the diagnosis can only be made when the patient is thoroughly narcotised.

Fibrous adhesions may be broken by forcibly opening the jaws, but very great subsequent care will be necessary to pre-

vent re-union, and it may be better to do Esmarch's operation of division of the bone in front of the angle.

In cases of ankylosis of the temporo-maxillary joint, the operation of excising the condyle of the jaw has been performed in a few instances. The first removal of the condyle was by Professor Humphry, of Cambridge, and was undertaken for chronic rheumatic arthritis, and the writer performed the same operation in a case of enormous hypertrophy of the neck and condyle of the jaw. In cases of complete synostosis of the articulation, it is more satisfactory to chisel through the neck of the condyle and remove a portion of it rather than to interfere with the articulation itself. This operation gives very good results, and the slight damage to the facial nerve resulting from the necessary incision parallel to the zygoma is unimportant.

CHRISTOPHER HEATH.

TENACULUM is a sharp-pointed hook which is fixed on a handle; it was formerly used for taking up arteries on the surface of wounds, but for this purpose it is now superseded by Liston's bulldog-forceps. It is a very useful instrument for drawing the trachea upwards, and for steadying it whilst its rings are being divided and whilst the tracheotomy tube is being inserted.

BILTON POLLARD.

TENDONS, Affections of.—**WOUNDS OF TENDONS** may be subcutaneous or open. The former are usually inflicted surgically, and are treated of under **TENOTOMY**. It will be sufficient to say here of these wounds that they heal readily, give rise to no constitutional disturbance, and require very little treatment beyond what is necessary for the correction of the deformity on account of which the operation was performed. Open wounds implicating tendons will require to be treated on the general principles applicable to such injuries. See **WOUNDS, Treatment of**. As regards the tendon, the treatment is simple. The severed ends must be united. This may be effected by stitching with carbolic catgut, chromic gut, or silver sutures. The two latter are better, because they do not loose their hold so readily as the common catgut. In an aseptic wound chromic gut is best, but in a suppurating wound silver would be necessary. In this last instance, however, it is very doubtful whether union would be effected, sloughing of a portion or whole of the tendon being more probable than union. In sewing the ends of tendons a curved

needle is best, and the continuous suture (unless silver is used). It is always advisable to make the parts aseptic, if possible, and prevent suppuration. For if the latter event occurs, there is apt to be spreading of the inflammation along the tendon sheath or sheaths, and sloughing of the tendons themselves. In the after-treatment such a position of the parts should be adopted as would relieve all strain on the tendon.

RUPTURE OF TENDONS occurs only in adults, is caused by sudden muscular contraction, and is most common in the lower extremity. The tendo-Achillis is most frequently torn, next the ligamentum patellæ, which is in reality part of the tendon of the quadriceps extensor cruris; in the upper extremity, the tendons of the biceps and triceps. The accident occurring in the lower extremity is usually from the person slipping, and making a sudden effort to prevent himself falling. The patient feels as if the part had been struck; there is a sharp pain for a moment; he falls to the ground and is unable to move the limb, and in some cases a crack has been heard. On examining the injured part, a distinct depression is felt at the point of rupture. The muscle is drawn up, and, in the case of the ligamentum patellæ, the patella is drawn up also, thus making the diagnosis easy as between fracture and rupture. Treatment is directed towards approximation of the torn ends of the tendon. This may be done by position. In the case of rupture of the tendo-Achillis, the leg should be flexed on the thigh and the foot extended. The patient may lie in bed or be permitted to go about with crutches, and the leg kept up by means of a cord passed through the heel of a slipper and secured to a belt round the thigh. When the ligamentum patellæ is ruptured, the limb should be kept straight and elevated, and the patella should be drawn down by strips of plaster, or by bandaging, as in fracture. See **PATELLA**, Fracture of the. A more thorough method of treatment is to suture the ends together. See *Wounds of Tendons*. This should always be done with strict antiseptic precautions. Such an operation cannot be performed when the tendon is torn from its insertion.

UNION OF TENDONS.—Union takes place more quickly in cut than in torn tendons. Also much more quickly and accurately when they are stitched than when they are not. In children union has been observed in two or three days, and in adults use of the part has been possible after a fortnight, or even ten days. It is doubtful whether

tendons contained in sheaths unite as readily as those which are not; but there is no doubt that the latter are more prone to slough after injury. Every care should be taken in their case, therefore, to promote union and avoid inflammation.

The new material which unites the ends of severed tendons is, at first, connective tissue with a large amount of cellular elements. Gradually the cells diminish and the fibres increase, the structure at the same time becoming stronger and harder, and like the original tissue. While this process is going on months may elapse, the time varying according to the amount of new material that has to be formed. At first this, when soft, is capable of being drawn out, and advantage of this fact is taken where tendons are cut (see **TENOTOMY**) for deformities, most surgeons allowing the divided ends to unite first and then extending them gradually by apparatus. It must always be remembered that the new fibrous material has also the property of contracting, and retains this for a long time.

DISLOCATION OR DISPLACEMENT OF TENDONS.—Those most frequently supposed to be displaced are the long head of the biceps at the shoulder; the tendon of the extensor carpi ulnaris at the wrist, in cases of fracture of the lower end of the radius; and the tendon of the peroneus brevis at the outer ankle.

Causes.—Most of the cases recorded have been associated with arthritic disease, or connected with some injury, such as fracture. Dislocation of the tendon alone may, however, occur from injury, and in such a case diagnosis should be easy. The tendon will be felt in an abnormal situation, while a hollow will be left where it came from. The muscle which acts through it will be inefficient, and the joint acted on will be stiff or useless. The tendon will probably be easily replaced after it is relaxed, but will not be likely to remain in its position on account of the sheath being torn.

Treatment will consist in replacing and retaining the tendon in position, if possible, by strips of plaster, bandaging, or other means. Inflammation will be prevented by cold applications, and after a few days *passive* movements should be employed to prevent adhesion of the tendon. Should reduction or retention be impossible, the patient may be comforted with the assurance that the parts will ultimately become almost as useful as ever.

Dislocated tendons are favourite injuries with 'bone-setters.' What they generally treat as such (and not infrequently successfully) are adhesions of ten-

dons to their sheaths after injury or rheumatism. *See* BONE-SETTING.

INFLAMMATION OF THE SHEATHS OF TENDONS.—Tendons themselves do not often inflame, but their sheaths do. This affection is always a serious matter. It may be divided into three varieties:—1. *Simple Acute Thecitis*, or *Tenosynovitis*; 2. *Simple Chronic Thecitis*; and, 3. *Suppurative Thecitis*, of which last whitlow is a common example.

ACUTE THECITIS.—*Causes.* Injury, strain, wound, amputation, rheumatism, extension of inflammation from a neighbouring joint.

Symptoms.—Pain along the tendon or tendons, aggravated by movement or pressure, swelling extending at first in the line of the tendons, a peculiar sensation, resembling crepitation, imparted to the fingers when passed over the part, due to the presence of fluid in the sheath; lastly there may be fluctuation.

Results.—There may be recovery under proper treatment, supervention of chronic conditions, adhesion of the tendon to its sheath from effusion and organisation of lymph, suppuration, which is liable to extend, and lastly sloughing of the tendon or tendons.

Treatment.—Rest, fomentations, leeches, blisters, incision to relieve tension. When suppuration has taken place, immediate and free incision is always necessary if the tendon is to be saved. Even when the effusion is only serous or sero-purulent, *aseptic* incision may be advisable. Thorough drainage should be provided.

CHRONIC THECITIS.—*Causes.*—Previous inflammation, injury (more especially a sprain), and the rheumatic condition.

Symptoms.—Pain and stiffness, weakness of the part (always a prominent symptom), tenderness and swelling, crepitation, or creaking from effusion. Loose bodies like melon-seeds may be in the fluid contained in the sheaths. There is not infrequently rheumatic arthritis of a neighbouring joint.

Treatment should be constitutional if there is rheumatism or arthritis present; locally rest (if possible), counter-irritation, pressure by strapping or elastic bandaging, tapping if there is much effusion, or free *aseptic* incision if there are lymph-bodies. Permanent weakness of the part from want of use, contractions or adhesions of the tendons to their sheaths, are very apt to follow.

Diagnosis.—Sometimes some difficulty may arise in cases of acute or chronic thecitis in differentiating them from sprains

or even fractures, and from disease of a joint. As regards the first, the two affections are often combined; in fact, inflammation along the line of one or more tendons is an almost necessary concomitant of a sprain of a joint. Where thecitis exists alone, the limitation of the pain and swelling at first to the line of the tendons, and the absence of ecchymosis afterwards, should be sufficient guides. The situation in which inflammation of tendon-sheaths is liable to be mistaken for fracture is above the outer ankle, where the peronei tendons cross the fibula, in which situation the presence of crepitation and pain on pressure are apt to make the hasty observer suppose that what he feels is the crepitus of a Pott's fracture obscured by swelling. The diagnosis should be made out by the absence of deformity and unnatural mobility at the painful part, by the ascertained integrity of the fibula, and by the mode of injury, which would not be eversion of the foot. Diagnosis from disease of a joint would be made by attention to the exact situation of the pain, swelling, &c.

SUPPURATIVE THECITIS.—This is most commonly met with in three forms. First, in connection with amputations and excisions, where there is suppuration which extends to and along the tendon sheaths; secondly, in cases of compound fractures or dislocations with suppuration; and, thirdly, in cases where the suppuration commences in the sheath, as in whitlow of the finger. The symptoms are those of suppuration generally; feverishness, often preceded by a rigor; swelling; heat; redness, which in the case of a whitlow disappears whenever tension is marked. Pain is always great.

Treatment consists in free incision. *See* WHITLOW.

TUMOURS OF TENDONS.—Fibromata, Enchondromata, Osteomata, Cysts (in the form of ganglia), and Gummata. Tendons are not liable to be affected by new-formations, but, on the contrary, resist their invasion longer than most textures. *See* TUMOURS; GANGLION; BURSE, Affections of. A. G. MILLER.

TENO-SYNOVITIS. *See* TENDONS, Affections of.

TENOTOMY signifies the subcutaneous division of tendon or fascia.

A narrow-bladed knife is introduced a short distance from the tendon to be operated on, and, guided by the finger, made to divide it. On its withdrawal, a piece of folded lint, with a strip of soap-plaster

across to fix it, is placed on the puncture, and the foot is bandaged to a splint, and kept at rest for four or five days until the puncture is healed. The result is the same as if no wound of the skin at all had been made, and as if no communication had ever existed between the severed tendon and the external air.

It has been shown on dissection, and proved by experience, that the ends of a divided tendon become perfectly united by an intervening substance, which, after a time, becomes indistinguishable from the rest of the tendon, and that the lengthening of the tendon by this means can be regulated by the extent to which the new tissue is gradually stretched during the first few weeks after tenotomy.

In the performance of tenotomy, care must be taken to keep the knife *close* to the tendon to be divided, so that no artery or nerve may be injured. But, as in almost all cases requiring this operation, the tendon or fascia is unnaturally prominent, owing to its contracted condition, there is not the same difficulty in finding it that there would be in the normal state, nor is there the same danger of wounding adjacent structures.

The chief tendons and fasciæ that may require division are:—The tendo Achillis, the tibialis posticus, the tibialis anticus, the peroneus longus and brevis, the plantar and the palmar fascia, the extensor longus digitorum with the peroneus tertius, the biceps femoris, the semitendinosus and the semimembranosus, the sterno-mastoid. There are some others that may require division, but these require no separate description. The method in which the tendons mentioned above are operated upon is as follows:—

THE TENDO ACHILLIS.—The operator sits at the end of a table, with the assistant on his left. The patient lies on his face on the table, with his foot slightly overhanging the end. The assistant then grasps the calf of the leg with his left hand, and the anterior part of the foot with his right, and flexes it slightly, thus bringing the tendon prominently forward. The operator then puts his left thumb on the tendon, and introduces a sharp-pointed tenotome flatwise beneath it, and at this moment the assistant, making further extension, he turns the knife and divides it from below upwards. When the assistant feels the tendon give way, he relaxes the extension. This is important, for, if it is not done, there is some danger of the knife slipping through the skin. In this operation the knife may be introduced

either on the inner or outer side of the tendon; but in the latter case it must be remembered that the posterior tibial artery is not far from the point of the knife, which should not be thrust in too deeply. With ordinary care there is no danger of wounding the vessel.

THE TIBIALIS POSTICUS.—The operator sits at the foot of a table, with the assistant on his left. The patient lies on the same side as the deformed foot, and, the other foot being held out of the way, the assistant grasps the leg firmly just below the knee with his left hand, and with his right holds the foot well flexed in the deformed position. The operator then feels for the inner edge of the tibia, and just over this, and about an inch (two inches in an adult) above the tip of the internal malleolus, makes a puncture with a sharp-pointed tenotome, and passing it down to the edge of the tibia, and, guided by this, opens the sheath of the posterior tibial tendon. The sharp-pointed knife is then withdrawn, the assistant being careful to keep the foot in exactly the same position. The operator, now holding a blunt-pointed tenotome like a pen, introduces it into the opening, and insinuates the blade flatwise between the tendon and the bone. Having indicated to the assistant to evert the foot, he turns the edge of the knife towards the tendon, and, supinating his wrist, divides it and also the adjacent tendon of the flexor longus digitorum. A snap is felt at the moment of the division of the tendons.

THE TIBIALIS ANTICUS.—The patient lies on his back, and the operator and his assistant place themselves as before. The operator works the foot from side to side, and feels with his forefinger for the tendon of the tibialis anticus. Keeping his finger over the tendon, he introduces a sharp-pointed tenotome with its edge towards it, between it and the tendon of the extensor proprius pollicis, and, the assistant making at this moment forcible extension, he divides it.

THE PERONEUS LONGUS AND BREVIS.—The patient lies on the opposite side to the deformed foot, and a cushion is placed under the lower part of the leg, with the foot extending over it. The operator sits at the foot of the table, with the assistant on his left. The assistant grasps the leg with his left hand, and with his right holds the foot up, so as to slacken the tendons as much as possible. The operator, placing his left forefinger on the tendons, introduces a strong, sharp-pointed tenotome flatwise, in an oblique direction, between

the fibula and the tendons two inches (in an adult) above the end of the malleolus, and having turned the edge towards the tendons, the assistant making extension, divides them.

THE EXTENSOR LONGUS DIGITORUM, AND THE PERONEUS TERTIUS.—The patient lies on his back. The operator sits at the foot of the table, with the assistant on his left. The assistant grasps the leg with his left hand and the foot with his right. The operator, keeping the fingers of the left hand on the tendons, introduces a sharp-pointed tenotome between the tendon of the extensor proprius pollicis and the tendons to be divided, and guiding the blade beneath these tendons, he divides them. Care must be taken not to dip the point of the knife deeper than necessary, or the anterior tibial artery may be wounded. The duty of the assistant will be rather to prevent the foot from suddenly falling than to make extension.

THE PLANTAR AND PALMAR FASCIA.—In the subcutaneous division of fascia, the object of the surgeon should be to divide every portion of it as efficiently as possible, and to retain the divided edges as much apart as possible. If it be found that one puncture is not sufficient for this purpose, two or more may be made. In the case of the plantar fascia, it is best to cut it bit by bit rather than to attempt to divide it all by one sweep of the knife, and it is a matter of indifference whether the edge of the knife be directed towards or from the skin.

The foregoing descriptions apply to a surgeon operating with his right hand on the tibialis anticus and posticus, or on the plantar fascia of the *left* foot, or on the peronei or extensors of the *right* foot. If the contracted tendons, however, are situated on the other side, and the operator cannot use his left hand, he must stand facing the foot of the table which is on his right.

BICEPS FEMORIS.—The patient lies on his face. The operator places himself on the same side of the table as the leg to be operated on. An assistant supports the leg in the flexed position. If possible, this operation should be performed without the previous administration of an anæsthetic. The patient should attempt to flex the knee-joint, the assistant holding the leg firmly at the same time. This will bring the tendon prominently forward. The operator then introduces a strong, sharp-pointed tenotome on the *inner* side of the tendon, keeping the blade close to it, and insinuates it under it. The knife then lies between

the tendon and the peroneal nerve, and, cutting outwards and upwards, the tendon is divided and the nerve is uninjured. On the knife being carefully withdrawn, the nerve will be observed to come more prominently forward than before, and care must be taken not to mistake this for part of the tendon.

THE SEMITENDINOSUS AND SEMIMEMBROSUS.—The knife should be introduced on the *outer* side of these tendons, and care must of course be taken not to dip the point deeper than necessary, owing to the position of the popliteal artery.

THE STERNO-MASTOID.—Either the sternal or the clavicular portion of the sterno-mastoid may require division. If it be necessary to operate on both portions, a separate puncture must be made for each. The patient lies on a table, and the operator stands on the same side as the muscle to be divided. A puncture is made on the *inner* margin of the muscle in its lower third. A blunt-pointed tenotome is then carefully introduced, on the flat, through the opening, and, guided round the border of the muscle, is passed behind it. The sharp edge of the knife is then turned towards the muscle, and made to divide it from within outwards. The assistant, during the operation, holds the head firmly and keeps the muscle tense.

HENRY F. BAKER.

TESTIS, Diseases of the.—**ACUTE INFLAMMATION.**—It is important to distinguish between inflammation of the epididymis and of the testicle proper or body of the organ. The former will be spoken of as epididymitis, the latter as orchitis. The two may be combined, the disease spreading from one organ to the other. Epididymitis is much more frequent than orchitis, and it is only rarely that the inflammation passes from the epididymis to the secreting part of the organ.

Causes.—The most frequent cause of epididymitis is inflammation or injury of the prostatic urethra or seminal vesicle, such as occurs in gonorrhœa, stricture, impaction of a calculus, the passage of a catheter or other instrument along the urethra, and lithotomy. Epididymitis is the commonest complication of gonorrhœa, occurring most often about the third week of the disease; it is due to a direct extension of the disease along the vas deferens, and not to metastasis. It is specially likely to occur in the subject of gonorrhœa after indulgence in alcohol, sexual excitement, violent exercise, or the use of strong injections or of a ca-

theter. Injury, such as a contusion against a saddle, is a frequent cause of epididymitis, and the disease is also excited by acute inflammation of the tunica vaginalis, such as is caused by stimulating injections in the radical cure of hydrocele. Acute hydrocele and epididymitis have also been met with in smallpox.

The causes of acute *orchitis* are injury, mumps, rheumatism, gout, and excessive ungratified sexual desire; very rarely it occurs in the course of typhoid or malarial fever. Orchitis is more frequent in certain epidemics of mumps than in others, and may occur without any affection of the parotid gland; it generally comes on towards the end of the first week of the disease, and is liable to be followed by atrophy of the organ. Acute inflammation of the testicle may be met with in infants and young children, as the result of injury, or, in some cases, as the result of phimosis; in other cases it appears impossible to assign a sufficient cause.

Pathology.—The inflammation is marked by hyperæmia of the vessels of the spermatic cord, of the epididymis and testicle, of the tunica vaginalis, and commonly also of the scrotum. In epididymitis, the greater part of the swelling is due to inflammatory exudation around the convoluted tube or tubes of this organ; but a similar exudation is found infiltrating the wall of the tube, and even filling up its lumen. In acute inflammation of the body of the organ, a small-celled inflammatory exudation is poured out between the seminal tubes; these are compressed by it, and, at the same time, become choked by the products of a hyperplasia of their epithelial lining. Inflammation of the tunica vaginalis very commonly accompanies acute epididymitis. This may lead to hyperæmia of the membrane and the effusion of a small quantity of fibrinous lymph on its surface, ending in adhesions between the two surfaces, or entire obliteration of the sac; or there may be an effusion of a richly fibrinous fluid into the sac—acute hydrocele—which then adds considerably to the swelling of the part. When the inflammation of the testicle is intense, the scrotal coverings are reddened by hyperæmia, and the veins especially may be engorged, and the tissues cedematous.

The disease most often terminates in complete resolution, but, in not a few cases, a small hard nodule is left behind in the globus minor of the epididymis, which on examination is found to be caused by a thickening around the duct of the testicle

and an obliteration of its lumen; the duct above this plug may be more or less dilated. This condition is of great importance, as, if it occur on both sides, it renders the subject of it sterile, and when of long standing it is incurable. Abscess is a rare termination of the disease, whether it affect the secreting part of the organ or its duct. A still rarer complication is gangrene of the scrotum, due to the intensity of the inflammation of the coverings of the testicle. When the body of the testicle is inflamed, the subsidence of the inflammatory process may be followed by atrophy of the organ. This more often occurs in connection with parotitis than in other varieties of orchitis, and is more frequent in some epidemics than in others, and it appears not to be dependent upon the intensity of the inflammation. Gonorrhœal epididymitis is more common on the left side, and rarely attacks both testicles simultaneously, although the second testicle may be attacked subsequently to the first. The affection is most frequent and generally most intense in the globus minor, and it is here also that the swelling remains longest, and is apt to leave behind a permanent thickening.

Symptoms and Diagnosis.—The onset of the affection may be very abrupt, but it is more often preceded by an aching pain along the spermatic cord of the same side, and, if an examination is made at this time, the cord is found full and the vas deferens more or less swollen. In exceptional cases, there is marked swelling of the cord for some hours previous to the swelling of the testicle. The severity of the symptoms of acute orchitis varies within somewhat wide limits; some patients are completely incapacitated by the disease, while the majority manage to attend to their usual avocations, albeit suffering more or less severely. The symptoms of the affection are swelling, pain, redness of the scrotum, together with evidences of constitutional disturbance. The swelling is always a marked feature of the disease, and has caused the name 'swelled testicle' to be commonly used for this complication of gonorrhœa. It varies in amount, position, and character with the parts affected.

When the epididymis alone is inflamed, the swelling is limited to the back part of the organ, where a slightly uneven, elongated, firm mass is felt, which projects above and below the unaffected body of the testicle. When the disease implicates the globus major or globus minor exclusively or principally, the swelling will be limited to or most extensive at the upper or lower

part of the organ. When the testicle is inverted, the swollen epididymis will lie along the front of the organ. The swelling due to orchitis proper is situated in front of the organ, and is more even in outline than that of epididymitis; owing to the unyielding tunica albuginea it never attains a great size. Acute hydrocele is a far more frequent cause of swelling over the front of the testicle. When the effusion is abundant, it greatly adds to the total bulk of the scrotal enlargement, and may cause a marked bulge in the front of the scrotum. This swelling is even in contour, and its fluid nature is recognised by the sense of fluctuation it affords. It obscures the testicle proper, but not the inflamed epididymis. The spermatic cord is more or less swollen and firm, the thickened vas deferens being tender to the touch. Edema of the scrotal coverings may add to the general swelling.

The pain is usually severe. It is described as of a heavy, dragging character, extending up along the cord to the groin, and round to the loin of the same side. The position of the tenderness is of use for diagnostic purposes; when the epididymis is inflamed, the tenderness is limited to this part of the organ; when, however, the body of the testicle is also inflamed, the tenderness as well as the pain is most marked over the front of the inflamed organ. Care must be taken in making this examination, for pressure made upon a healthy part may be transmitted to an inflamed part, and cause pain; this error is, however, easily avoided. The scrotal coverings may be scarcely at all affected; generally the skin is reddened, the superficial veins are distended, and the dartos is more or less cedematous. The constitutional disturbance is manifested by fever, a quickened pulse, a furred tongue, anorexia, and constipation.

Under judicious management the pain, tenderness, and fever quickly subside, and the swelling gradually diminishes, in most cases leaving a painless induration of the globus minor of the epididymis, which slowly disappears but may be permanent. When the acute symptoms have subsided and the swelling has been entirely, or in great part, absorbed, the testicle may be left in a very irritable condition, painful, very tender to the touch and on contact with the clothes and thighs in walking; and this state, which is one of considerable importance, is apt to be chronic and difficult to alleviate. When the duct of the testicle is plugged by lymph, not only is the testicle useless for fertilising purposes, but the act of intercourse is apt

to be followed by pain and swelling of the gland. The occurrence of abscess is attended with persistent and even increasing pain and tenderness, increase of the swelling at a particular part, and fluctuation; with these local symptoms there is fever, and there may be one or more chills or rigors. Abscess most often occurs at the globus minor and points at the lower end of the scrotum. In delicate, strumous subjects, the abscess may be subacute or chronic in its course. Gangrene of the scrotum is to be feared when the swelling of its tissues reaches a high grade. Gangrene of the testicle itself can only be verified when, at the bottom of an abscess of the scrotum, the sloughed organ is seen. Atrophy of the testicle gives rise to no symptoms except a wasting of the body of the organ, the epididymis not being affected.

The *diagnosis* of acute inflammation of the testicle, as a rule, presents no difficulty; the acute onset of the disease, the swelling of the testicle itself, the severe pain and tenderness, the fulness and thickening of the cord, and the fever are eminently characteristic. By the shape and position of the swelling, and the site of greatest tenderness, epididymitis is readily distinguished from true orchitis. The signs by which acute hydrocele, abscess, and gangrene are to be recognised have also been already stated. Acute inflammation of a retained testicle may be mistaken for a strangulated hernia. For the diagnosis, *see* TESTIS, Malpositions of the.

Treatment.—In the acute stage of the disease, it is very important that the patient should be at rest in the horizontal position with the scrotum well supported, either by a pillow between the thighs, a handkerchief suspender, or a broad strip of strapping passed across from groin to groin. When the case is seen early, and the patient is young and otherwise healthy, cold is the best local application. The usual plan is to suspend a bag of cracked ice to a bed-cradle, so that it rests lightly upon the scrotum; but a still better plan is to surround the scrotum by a coil of rubber tubing through which iced water circulates; the coil being similar to that used by Otis for the penis. Should cold fail to relieve the pain, or if the patient be old or cachectic, or the inflammation have lasted more than twenty-four hours before treatment is commenced, or be associated with mumps, or if there be great edema of the scrotum, local heat is to be employed, combined with the application of belladonna or opium. Hot belladonna or poppy-head fomentations may be

used; but a simpler and equally beneficial plan is to cover the testicle with a thick layer of equal parts of extract of belladonna and glycerine spread on linen, and over that to apply hot fomentations, which should be renewed every hour, the belladonna being re-applied once a day. The diet should be restricted to unstimulating slops, and the bowels be well opened by a saline purgative combined with tartar emetic, a good formula being, a drachm of sulphate of magnesia with $\frac{1}{4}$ grain of tartar emetic, given every four hours until a distinct effect is produced upon the bowels. In robust, plethoric young men, this may be preceded by a purgative dose of calomel (gr. v. to x.), but in the majority of cases this is not requisite. Under this treatment the acute symptoms as a rule quickly subside, and the patient is able to get up in forty-eight or seventy-two hours, but convalescence is much hastened by a continuance of rest in the horizontal position. In the orchitis of mumps, neither cold nor any form of lowering treatment is to be employed, and, owing to the frequency with which atrophy of the testicle follows this form of the disease, great care is to be exercised in the treatment of even the mildest case; a diaphoretic and diuretic saline mixture is the best internal remedy.

When the tunica vaginalis is distended with fluid and the seat of acute pain, rapid and marked relief is obtained by puncture of this sac either with a fine trocar or a narrow knife; but the puncture should not extend into the testicle itself. When abscess is diagnosed, it should be opened by means of a fine knife, and a small drain of catgut, horsehair, or rubber tubing may be introduced into the cavity. If the oedema of the scrotum is so intense as to threaten strangulation of its vessels, it should be at once relieved by several incisions about three-quarters of an inch long, and over the part boracic acid fomentations should be assiduously applied. When there is great congestion of the scrotal veins, and the patient is plethoric and the disease acute, relief will be obtained by a local venesection. The man should stand up for a few moments, and then one or more of the largest veins of the scrotum should be opened by a lancet, and from three to six ounces of blood may be abstracted. When the disease is not very acute and the patient cannot rest entirely, the best local treatment is belladonna and glycerine on linen, covered by a thick mass of cotton-wool, the whole being enveloped in oiled silk or india-rubber tissue, and supported in a handkerchief. The handkerchief

should be folded three-cornerwise, and a piece of tape is to be sewn to the middle of the longest side; this part is to be placed behind the scrotum, and the tape drawn up between the buttocks and fastened to a band round the waist; the two long ends of the handkerchief are to be drawn up along either groin and fastened in front to the same band, and the remaining corner is then to be folded up in front and pinned to the waistband. By this means the testicle is not only held up, but also kept forwards out of the way of the thighs in walking. Two or three times a day, the testicle should be well fomented with water as hot as can be borne. See SUSPENSORY BANDAGE.

When the period of acute pain and congestion is passed, the patient should, if possible, still rest, but when necessary may be allowed to get up, wearing a well-fitting suspender. Gentle friction with a small piece of belladonna ointment night and morning is the only local treatment required in most cases. But where the effusion has been great, or its absorption occurs slowly, this may be hastened by carefully applied circular compression of the testicle. This compression may be obtained by strapping, an elastic bandage, or a laced suspender. Where an indolent nodule is left behind in the globus minor of the epididymis, friction with unguentum hydrargyri is the best application, and should be persevered with until no thickening or induration is to be detected. All urethral medication and instrumentation are to be suspended during an attack of epididymitis. The discharge of gonorrhoea usually lessens and disappears during the acute stage of epididymitis, but reappears on its subsidence; this is not evidence of metastasis, but of the derivative effect of the testicular inflammation. In malarial orchitis, which is liable to relapse, quinine should be exhibited. In gouty orchitis, the usual treatment for this diathetic condition is indicated, alkaline salines with colchicum being exhibited, and the diet being suitably restricted. Where the condition of irritable testicle, above referred to, exists, iodide of potassium (gr. x. to xv. a day) should be given; if the patient be anæmic, iron and cod-liver oil with change of air will afford most speedy relief. This condition is often very obstinate and difficult to relieve.

CHRONIC INFLAMMATION.—*Causes.*—By far the most frequent cause of chronic orchitis is constitutional syphilis. The testicle becomes affected most often within two or three years of the occurrence of infection, between the subsidence of the

secondary eruptions on the skin and mucous membranes and the development of the deep tertiary diseases of bones and viscera. But syphilitic orchitis may come on at a much later period, and in patients in whom there is no other concurrent syphilitic phenomenon. It is believed that the affection is often excited in the testicle by slight blows or by venereal excesses. Occasionally, chronic orchitis develops in young infants the subjects of hereditary syphilis. Stricture of the urethra sometimes leads to chronic inflammation of the testicle, and, in some cases, exposure to cold and wet or prolonged venereal excess has seemed to be the starting-point of the disease. Gout, rheumatism, or long residence in malarious districts, may induce chronic orchitis; and very occasionally it is a sequel to acute traumatic orchitis.

Pathology.—The morbid change in the testicle consists in a chronic inflammation of the intertubular tissue of the organ, which, with rare exceptions, is limited to the secreting part of the gland, and does not spread to the epididymis. In many cases, if not in all, the inflammation first affects the tunica albuginea, and spreads in from this membrane along the fibrous dissepiments of the organ, involving lobe after lobe, but very rarely, if ever, extending as far as the rete testis and the vasa efferentia. The tunica albuginea becomes considerably thickened, and, as at first the disease is limited in area, the part has a nodular feel, but, as the affection spreads and involves more of the fibrous covering of the organ, this nodulation lessens and is lost. The inflammation may extend inwards uniformly over several lobes, or may be limited to certain lobes, and attain a higher grade in particular spots; and, in this way, variations in the appearance presented by the diseased organ are produced. The inflammatory exudation consists of small round nucleated cells and delicate fibres, which surround and separate the seminal tubules; the epithelium lining these tubules undergoes fatty degeneration and is shed. When the inflammation does not attain a high grade or continue very long, the exudation may be absorbed and the damage done to the tubules be repaired, the testicle being restored to its original structure and function; if, however, the injury done to the tubules have been too severe to permit of this, the absorption of the inflammatory exudation is attended with wasting of the organ, and, when this is total and bilateral, it induces both impotence and sterility. On the other hand, the inflammatory neoplasm

may organise into dense cicatricial fibrous tissue, in which no trace of the tubules is to be detected, or it may undergo slow degenerative changes.

When a gradual obliteration of the arterioles occurs, with dry fatty degeneration of the tissue, typical gummata are produced. In other instances, the degenerated tissue breaks down into fluid debris; this may be encapsuled in firm fibrous tissue, or, inflammation being excited around it, the testicle becomes adherent to the scrotum, and an opening is formed through which the puriform matter is discharged. From the wall of the cavity thus emptied an active growth of granulation-tissue takes place, which fungates through the sinus. *See HERNIA TESTIS.* Where the chronic inflammation has its chief seat in the tunica albuginea, the thick exudation on the outer surface of this membrane may undergo similar changes; the tissues of the scrotum then ulcerate and expose the testicle, from the surface of which granulations may sprout, or the part may exhibit the sloughy appearance common in cutaneous gummata. The tunica vaginalis is generally involved in the inflammation; at the early stage fluid is effused, generally in small quantity, which fluid, unlike that of simple chronic hydrocele, may coagulate spontaneously. Later on, the fluid is absorbed, and the two serous surfaces of the tunica vaginalis may be partially or wholly adherent. When hydrocele is combined with chronic enlargement of the testicle, the condition is known as *hydrosarcocoele*; the fluid is occasionally so abundant as to entirely obscure the testicle. The vessels of the cord are engorged, giving a sensation of fullness to the part; very rarely it is indurated, and it has been known to become the seat of gummatous enlargement. The tissues of the scrotum are generally unaffected; but when the inflammatory products in the testicle soften down, the skin and subcutaneous tissues become inflamed, adherent, and at length ulcerated. Syphilitic orchitis affects both testicles more often than any other disease to which these organs are subject. It is rare for both testicles to be attacked simultaneously; more commonly, the inflammation advances for some time in one before spreading to the other organ, or it is only after the subsidence of the disease in the first that the second becomes affected, and there may be a considerable interval of time between the invasion of the two testicles.

The epididymis usually escapes altogether in syphilitic orchitis; it may, how-

ever, be involved either with or separately from the body of the organ. The change is the same as in the secreting part, consisting of an interstitial inflammation between the tubes of the globus major and in the fibrous covering of the coni vasculosi.

Symptoms and Diagnosis.—The onset of the affection is often unobserved by the patient, who has his attention first called to the part by accidentally feeling a hard lump in one testicle. In some cases, however, the testicle is tender from the first. In harmony with its insidious onset is the slow and painless course of the disease. The testicle is enlarged, and sometimes attains as much as three times its original bulk, being ovoid and flattened on its sides, and generally by its increased size obscuring altogether the epididymis. In the earlier stages, the enlargement is nodular and affects only a part of the body of the testicle, but, later on, the irregularities of the surface lessen and more of the organ may become involved, until no part of it is felt to be healthy. The inflamed part is firmer than natural, and oftentimes is of extreme and even stony hardness. The special testicular sensibility is lost early, and there may be an entire absence of both pain and tenderness; but more often the part is tender to pressure at some spot, and, occasionally, patients make considerable complaints of both pain and tenderness, but these acuter symptoms are rare and generally transient, the usual course of the disease being insidious, slow, and painless.

The spermatic cord is usually fuller than normal, but is not indurated. Fluid is often present in the tunica vaginalis in greater or less quantity, increasing the swelling and obscuring the exact outline of the testicle; this can be detected by the presence of fluctuation, and also by translucency of the anterior part of the scrotal swelling. The term *hydrosarcocele* is applied to this condition. The skin of the scrotum is generally of normal appearance, but when the inflammatory products in the testicle soften, it becomes adherent to the organ, reddened and inflamed, an abscess bursts and a sinus may be left, or extensive ulceration occur, or a hernial protrusion from the testicle develop. The opposite testicle may be healthy, or may be similarly affected, the disease attacking one testicle after the other. Relapses and recurrences of the affection are also met with. A history of syphilis is to be obtained in the great majority of cases, and in many cases there are other evidences of this disease present at the time. When both organs are involved in the inflammation, sexual desire and power are alike lost, and this condition

is permanent when the testicles atrophy or the inflammatory products develop into dense cicatricial tissue. In some instances of apparent cure of the disease, the semen continues to be void of fertilising power.

Under suitable treatment, the induration and enlargement of the testicle generally disappear, testicular sensibility returns, and the part is restored to its former condition. In some cases, however, the organ wastes away, and nothing may be left but a small nodule adherent to the front of the unaffected epididymis. In other instances, when the disease has run a very chronic course, and has converted the testicle into a mass of cicatricial tissue, the organ remains of irregular outline, extremely hard and painless. Hernia of the testicle is considered elsewhere. When, with considerable enlargement of the testicle, one prominent nodule is felt, and this nodule resists the effects of treatment more than the surrounding parts, it is probably a gumma. Gumma of the testicle is not infrequently unilateral, and it is met with at a later period in the course of syphilis than simple interstitial inflammation. In many cases, it is impossible to recognise the presence of gumma except by dissection of the organ. When, in spite of careful and prolonged local and constitutional treatment, the testicle remains enlarged, hard, and the seat of occasional attacks of pain, it will generally be found, on removal of the organ, that it is the seat of a chronic abscess with a thick indurated wall of fibrous tissue surrounding the inflammatory débris.

The *diagnosis of Chronic Orchitis* is generally easy: the gradual painless enlargement of the testicle proper, with marked hardening and loss of its special sensibility, the absence of induration of the cord, the affection of both testicles in many instances, the existence of syphilis, and the good effects of anti-syphilitic remedies are the main factors in arriving at a diagnosis. *Hydrosarcocele* has to be distinguished from simple hydrocele; in the latter the testicle becomes enlarged and is generally somewhat tender; the enlargement, however, mainly affects the epididymis, which can be plainly distinguished from the body of the organ. In *hydrosarcocele*, on the other hand, when the fluid has been withdrawn from the tunica vaginalis, the body of the testicle will be felt enlarged and hard, and the epididymis will be obscured altogether; it is only rarely that the amount of fluid in the serous sac is sufficient to render this diagnosis at all doubtful. The swelling of *hæmatocele* usually follows upon an in-

jury and develops quickly; it is, moreover, less nodular and hard than that of chronic orchitis, being elastic or even fluctuating, rarely if ever bilateral, often attains a larger size than an inflamed testicle, and does not yield under anti-syphilitic remedies.

In the early stage, it may be impossible to distinguish *malignant disease* from chronic orchitis; but the continuous and rapid enlargement of the organ, the thickening of the cord, the adhesion of the scrotal coverings, the swelling of the deep inguinal and lumbar glands, and the freedom of disease of the opposite organ, as well as the effects of treatment, will quickly dispel all doubt as to the real nature of the affection. The diagnosis from *strumous orchitis* is very important, and usually it is very easy. In the strumous affection, the epididymis is the first and chief seat of the disease, and this part becomes enlarged and markedly nodular, which is in marked contrast to the slightly nodular and very hard enlargement of the body of the organ in chronic orchitis. Strumous orchitis is much less often bilateral; nodular enlargement of the cord and of the vesicula seminalis of the same side or prostate is common, while tubercular disease of the bladder and kidneys, or of the lungs, only too often renders the diagnosis clear. In strumous disease, the tendency for the inflammatory products to break down into an abscess, is much more marked than in syphilis. *Syphilitic epididymitis*, which occurs early in the course of the disease, and is much rarer than the affection of the body of the organ, will be recognised by the very slow, painless, hard, and bossy enlargement of the globus major, in a patient known to be the subject of syphilis. The chronic orchitis due to gout, malaria, or stricture of the urethra is more general, less nodular, and less hard and painless than that due to syphilis; gumata do not form in connection with it.

The chronic orchitis of infants must be carefully distinguished from malignant disease of the organ, which is also met with early in life. The slow and painless enlargement of the organ, the absence of glandular infection, the affection of both testicles, and evidence of the syphilitic dyscrasia, are points upon which a diagnosis of chronic orchitis may be founded. As in adults, so in infants, hernia testis may result from chronic orchitis.

Treatment.—The treatment of chronic orchitis must be both local and constitutional. Where the disease is syphilitic in origin, and the testicle is considerably enlarged, it should be firmly strapped with

emplastrum hydrargyri or the emplastrum ammoniaci cum hydrargyro. In cases where the enlargement is slight and partial, inunction with mercurial ointment is a better local application, and if there is marked tenderness, unguentum belladonnæ, either alone or combined in equal proportions with ung. hydrargyri, will quickly relieve this symptom. In place of the common mercurial ointment, the ointment of the red oxide or red iodide of mercury, of the strength of ten grains to the ounce, may be used. When inunction is employed, a suspender should be worn. Mercury should also be administered internally in the majority of cases; the drug may be given in any of the usual forms—by mouth, by inunction, or in the form of vapour. Where the patient has not previously had a proper mercurial course, he should be quickly brought under the influence of the drug up to the point of slight swelling of the gums, and this condition should be kept up until all traces of the disease have passed away.

When the patient has been already submitted to a prolonged course of mercury, a milder treatment with the drug will usually quickly lead to improvement. It is a common plan, in such cases, to combine iodide of potassium with the mercury in the form of a biniodide. When the patient has been already thoroughly treated with mercury, and especially when the testicle is affected many years after the primary infection, or when, from the local condition, the disease is believed to be gummatous, and the patient is markedly cachectic, iodide of potassium should be given alone in full and increasing doses, combined with sarsaparilla or cinchona; and when cachexia is marked, cod-liver oil, iron, bracing sea-air, and good food are valuable adjuvants. Mercury is the drug to be relied upon in most cases, and iodide of potassium cannot be successfully substituted for it, unless the patient have been previously thoroughly treated with mercury. For the treatment of hernia testis, see HERNIA TESTIS. When the tunica vaginalis contains only a small amount of fluid, no alteration in the treatment is required, the fluid being quickly absorbed under the influence of mercury; but when the hydrocele is a marked element in the case, greatly adding to the swelling, it is well to tap it, and then to strap the testicle, and should the hydrocele persist after subsidence of the orchitis, the radical cure of the former should be made; this is very rarely necessary. See HYDROCELE. No treatment is of avail where the testicle is atrophied, or

is converted into a mass of dense fibrous tissue.

When, in spite of appropriate local and constitutional treatment, continued for some time, the testicle remains enlarged and hard and is the seat of recurrent attacks of pain, the organ should be removed, as in all probability it is the seat of a chronic abscess. Castration should also be resorted to when the testicle is riddled with chronic sinuses, or is greatly enlarged with gummata, and improvement is not speedily obtained from medicinal treatment. This operation should not be performed until the surgeon is persuaded that the testicle is beyond all hope of recovery; when the syphilitic cachexia is well-marked, the removal of an ulcerated gummatous testicle is often followed by marked improvement in the general condition. Chronic syphilitic epididymitis should be treated by local inunction with mercurial ointment and the internal administration of mercury.

In the few cases of chronic orchitis which are not due to syphilis, the enlarged organ should be carefully and systematically strapped; where there is marked tenderness, emplastrum belladonnæ is used with advantage; where the induration is a marked feature in the case, emplastrum hydrargyri should be used. If the patient is gouty, the diet and mode of life should be carefully regulated, and alkalies with colchicum should be given. When malaria is the probable cause of the affection, removal from the malarial climate—best of all a sea voyage—and the administration of quinine are the most successful measures to adopt. If quinine fails, arsenic should be tried, and iron and cod-liver oil are often of great benefit when the patients are anæmic and thin. When there is a stricture of the urethra, this should be treated. In all cases alike of chronic orchitis, the patients should abstain carefully from alcoholic excess and all forms of sexual excitement.

The chronic orchitis of infants requires the same treatment as that of adults; mercury should be administered internally in the form of grey powder or by inunction of ung. hydrargyri, and this ointment may also be applied locally. The little patients are usually cachectic, and require careful feeding and cod-liver oil.

TUBERCULAR DISEASE OF THE TESTIS.—

Causes.—In a large proportion of cases, the disease in the testicle is secondary to tubercular affection of other parts of the body, especially the lungs, bones, kidneys, and bladder; in some of these cases, an attack of acute gonorrhœal epididymitis, or local ex-

posure to cold or injury has appeared to light up the disease in the testicle. In many cases, however, the tubercular disease of the testicle is a primary affection. Tubercle attacks the testicle in the same class of patients and under the same general conditions as other organs, and there is much reason to believe that it is connected with the development of the bacillus tuberculosis. The testicle may be affected in general military tuberculosis. The disease is occasionally met with in young children, and is most common in early manhood.

Pathology.—The common tubercular or strumous disease of the testicle consists of a chronic inflammation commencing in the epididymis, and sometimes spreading to the body of the testicle or to the vas deferens. The convoluted tubes of the epididymis become considerably swollen and filled out with cheesy débris. The inflammatory products usually undergo a slow caseous change, becoming yellow and friable, and they often, subsequently, soften down into abscesses containing thin pus with curdy or even calcareous flakes. Where the disease is very chronic, the cheesy masses are encapsuled by firm fibrous tissue, and may become calcified. Much more often, however, the inflammation spreads to the surrounding tissues, and the broken-down matters are discharged externally, and a sinus remains which may continue for months, or even years, to discharge a thin flaky pus, and in the more favourable cases may then gradually heal up. The disease most often, but not invariably, begins in the globus major, and, as it spreads to the rest of the organ, the tubercular deposit assumes a nodular form, and the separate nodules or masses often undergo their degenerative changes with different degrees of rapidity, resulting in a succession of abscesses and sinuses.

The disease generally spreads along the vas deferens, the walls of which become swollen and thickened, and nodular accumulations of caseous matter may collect in it. From the vas deferens the disease reaches the prostate and the vesicula seminalis of the same side. In these organs similar changes occur. They become enlarged and nodular, and cheesy masses of tubercular matter are found in them; these, like those in the epididymis, may soften down and open into the urethra or bladder, or discharge themselves through sinuses burrowing in the pelvis between the bladder and rectum. From these organs the disease extends to the bladder, and in some cases up along the ureter to the kidney; in the urinary

organs the tubercular deposit quickly ulcerates. From the epididymis the disease often spreads forwards into the body of the testicle, advancing in a regular manner from the mediastinum testis to the front of the organ. Here, the inflammatory products first assume the form of small, firm, grey, pearly nodules or 'granulations,' situated in the lobules of the organ—not in the fibrous septa—which increase in size and number and then coalesce into larger masses, undergoing fatty degeneration, caseation, and softening, as in the epididymis. If abscesses occur the scrotum becomes adherent to the testicle and inflamed, and the pus is discharged externally, and from the opening thus formed a fungous protrusion occasionally occurs. See HERNIA TESTIS.

The rapidity and distribution of the morbid changes vary within wide limits. In all cases alike, the epididymis is first and most severely affected. In some cases, the body of the gland becomes involved early in the disease, large masses of tubercular deposit being found in it; in other cases, the change here is long delayed, and consists of such small deposits of tubercle that they occasion no external sign of their presence. This part of the organ may escape altogether. There is the same variation in the rapidity with which the vas deferens, prostate, seminal vesicle, and bladder become implicated. From the testicle tubercular infection may be carried to distant organs, especially the lungs, and the patient may succumb to general miliary tuberculosis. Similarly, the testicle may show fine grey granulations scattered through the secreting part of the organ, in any case of general tuberculosis. The opposite testicle is often attacked with tubercular disease; in other cases, the body of the unaffected organ rapidly wastes. The tunica vaginalis usually escapes altogether; it may, however, contain an excess of fluid, or its cavity may be partially or completely obliterated by adhesions.

Some difference of opinion exists as to the exact starting point of the tubercular inflammation; probably, it is in the lymphoid tissue that surrounds the tubes. The swelling, in its early stage, consists of a fine nuclear growth in a delicate reticulum, which infiltrates the walls of the tubes and lies in masses between them. The epithelium lining the tubes proliferates, and is shed into and blocks up their lumen. The small vessels in the part become thrombosed or obliterated by the pressure of the new-growth, and, as a result of the gradual diminution of the blood-supply, the inflammatory neoplasia undergoes fatty degene-

ration, and is ultimately converted into a dry granular débris. From more acute processes occurring around these cheesy masses, serum is exuded into them, softening them down into the thin, curdy, flaky pus which is so characteristic of strumous or tubercular abscesses.

Symptoms and Diagnosis.—The origin of the disease is very insidious, and the enlargement of the testicle often reaches some size before it is accidentally noticed by the patient. There is generally no pain or tenderness in the part until the tubercular deposit is softening down into an abscess; the pain then may be only trivial, but sometimes it is severe and is only relieved by the discharge of the pus. The first sign of the disease is a firm nodular enlargement of the epididymis, which generally commences in the globus major and then spreads to the rest of the organ, and forms an irregular crescentic mass behind the testicle. The swelling is firm, unyielding, and usually free from tenderness. The body of the testicle may be quite unaltered, or it may be shrunken and softer than normal, or, at a later period of the disease, a firm lump may be felt in it towards the back and continuous with the enlarged epididymis. The peculiar sensibility of the testicle is preserved, or only lost when the body of the organ is extensively diseased. Hydrocele is infrequent, and, when it is met with, is often partial and slight, being an accumulation of serous fluid in only one small portion of the sac. The cord is full, and early in the disease the vas deferens is felt enlarged—sometimes to the size of a pencil—and nodules may be found in it. The scrotal coverings are unaffected in the earlier periods of the disease.

The nodular enlargement of the epididymis may diminish, and, if calcification of the deposit occur, a very hard callous lump is all that can be detected. More often, the disease slowly but steadily advances, and softening occurs. As the swelling increases, the scrotum is found to be adherent to the contained organ at some one or more places, and it then becomes reddened and projects as a fluctuating tumour which, after a time, bursts and discharges thin pus with curdy or calcareous flakes in it; a sinus remains behind, which gives exit to a thin serous fluid, with occasional flakes of calcareous or cheesy matter. This sinus may heal up: more often it continues open. This process may be repeated at several spots until several sinuses exist, leading down to the epididymis and body

of the testicle, the organ being reduced to an irregular shrunken nodule. As the disease begins and is always most advanced in the epididymis, these abscesses and sinuses are most often found in connection with this part of the organ. Occasionally, a fungous protrusion of granulation-tissue from the testicle may be met with, but this is much less frequent than in connection with syphilitic sarcocele. See HERNIA TESTIS.

The opposite testicle may remain unaffected quite to the last, but often it, too, is diseased in the same manner; while, in some cases, atrophy of the organ is early and rapidly produced. When, as very often is the case, the vesicula seminalis and prostate are implicated, a nodular enlargement of these organs is detected on rectal examination, and the enlarged vas deferens may be felt lying on the inner side of the vesicle, immediately behind the prostate. When the disease spreads to the bladder and ulceration occurs, the patient's distress is greatly aggravated by the frequent painful micturition and the discharge of blood and pus in the urine. The general health of the patient at the same time suffers; he shows the pallor, anæmia, and debility so characteristic of tubercular diseases, and, as a rule, there is evidence of disease of the lungs, larynx, glands, or bones, which may precede or follow that in the testicle. In the later stages, wasting and hectic fever become more and more marked, and lead on to death; but in other cases a generally diffused miliary tuberculosis closes the scene. The existence of grey miliary tubercles in the testicle does not occasion any change in the organ, permitting of the recognition of this form of the disease during life.

The *diagnosis of Tubercular Sarcocele* rests partly upon local and partly upon constitutional signs. The local signs to be specially noted are the slow, painless, nodular enlargement of the epididymis, which only late, if at all, spreads to the body of the testicle, the preservation of the special testicular sensibility, the thickening and nodular swelling of the vas deferens, and the enlargement of the seminal vesicle on the same side, and often also of the prostate. Later on, these nodular masses tend to adhere to the scrotum, and break down into abscesses and leave sinuses discharging thin sero-pus. The site of the disease distinguishes it from chronic orchitis; the chronic syphilitic epididymitis, which is sometimes met with, has no tendency to soften into an abscess or to gradually spread and involve the rest of

the organ, while it is accompanied by other evidences of secondary syphilis. Tubercular orchitis is rare in childhood and old age; and the frequent concurrence of phthisis, or of tubercular disease of glands, bones, or joints, together with the delicate appearance and general health of the patient, are the constitutional phenomena leading to a correct diagnosis.

Treatment.—When the disease is limited to the testicle, and there is no evidence of tubercle in any other part of the body, the diseased organ should be removed at the earliest possible moment, and afterwards care should be taken to place the patient in the most favourable hygienic conditions. Should the disease recur in the opposite testicle, the surgeon must not hesitate to remove it also, provided the disease be limited to that organ; and, if a patient present himself with tubercular disease of both testicles, but be free from tubercle of other organs, both testicles should be at once removed. The necessity for this prompt and radical treatment arises from the tendency of the disease to spread to the urinary organs, infect the lungs or other distant organs, or form the starting-point of generally disseminated tuberculosis. Unfortunately, owing to the insidious origin and slow painless course of the affection, it is rare for the patient to come under treatment at this early stage, while, in many cases, the disease in the testicle is secondary to disease in the lungs and other organs. Should the seminal vesicle or prostate be already enlarged and indurated, castration is not to be recommended.

In the more frequent case of disease of the testicle associated with tubercle in other organs, the best results will be obtained from careful attention to the general health. The patient should, if possible, reside at the seaside for a prolonged period, or, better still, take a long sea voyage. His diet should be carefully regulated, and cod-liver oil should be taken in such quantity as can be well borne. Other tonics, especially the iodide of iron, arsenic, and quinine, will be found useful under the varying conditions of the patient's appetite, &c. The testicle should be carefully suspended, and painting the scrotum with tincture of iodine, or inunction with an ointment containing ten grains of iodoform to the ounce or the ung. plumbi iodidi, appear to be useful. When there is local pain and tenderness, belladonna ointment may be advantageously substituted. Rest in the recumbent position must be maintained as much as possible. Sexual excitement should be entirely

avoided, and riding or violent exercise of any kind is equally harmful, although a gentle daily walk, short of producing a sense of fatigue, is a valuable adjunct to the general treatment.

When it is evident that the tubercular deposit has softened down, and fluctuation is detected, an incision should be made into the abscess, and if this subside into a sinus discharging a little sero-pus, the surgeon should content himself with keeping the part clean and injecting tincture of iodine into the sinus from time to time. When, however, the suppuration is more abundant, and fresh abscesses form, and particularly when the testicle is the chief seat of the tubercular disease, or the changes in it are believed to be the main cause of the constitutional condition, more active measures should be taken. The best plan is to enlarge a sinus and, through the wound thus made, to scrape out all the cheesy deposits by means of a sharp spoon. Care should be taken to do this thoroughly, as the success of the measure largely depends upon the removal of all the degenerated tubercular material. The cavity left should be stuffed with iodoform gauze, or powdered iodoform and salicylic silk, and allowed to close by granulation. When the disorganisation of the body of the testicle is so advanced that castration would be a simpler procedure, it should be preferred. The removal of the tubercular deposit, if completely executed, affords good results and is not a serious procedure, and it should certainly be undertaken in preference to castration when the degenerative changes are limited to the epididymis.

IRRITABILITY OF THE TESTIS.—Under this name are included cases of undue sensibility of the testicle.

Causes.—While the organs are undergoing their normal development at puberty, they may become hyperæsthetic; a more frequent cause of this condition is onanism, or excessive sexual indulgence, and in some cases the pain is traceable to prolonged but ungratified erotic excitement. Varicocele may be associated with 'irritable' testicle, and an atrophied testicle—whatever the cause of the wasting—is often the seat of excessive sensibility. More rarely, the affection appears to depend upon abscess or irritability of the prostate gland and prostatic urethra. In many cases there is no local cause for the malady, and such patients are generally weakly anæmic men, or are the subjects of dyspepsia.

Pathology.—There is no known pathology of this condition; in some cases the

testicles, apart from any of the above local conditions, are rather soft and flabby.

Symptoms and Diagnosis.—The patients complain of an extreme sensibility of one or both testicles, often most marked in the epididymis. This may be so great that the movements of walking, the contact of the dress, or the gentlest digital examination, excites acute pain. The affection is often bilateral, and when it affects one testicle only is more frequent on the left side. If the patient is at rest, and particularly if the scrotum is suspended, there is no spontaneous pain. The organs are at the same time free from all obvious and coarse painful lesions, such as inflammation and new-growths. The diagnosis of irritable testicle is very readily made, but pains must be taken to determine its cause, as only when this is known can treatment be adopted with confidence and success.

Treatment.—In all cases a well-fitting suspender should be worn, either next the scrotum or over a layer of cotton-wool, and cold douches to the part are generally beneficial. Where the changes of puberty are supposed to be the cause, patience must be exercised, and the application of belladonna liniment or ointment may afford relief. All sexual abuses must be stopped, and in some cases the sedative influence of bromide of potassium is very valuable, while in other instances the regular sexual relation of marriage removes the morbid sensibility of the testicles. Where there is varicocele or disease of the prostate, appropriate measures must be taken to cure these conditions. Strict attention should be paid to the diet and the state of the digestive organs, and, where there is anæmia, iron should be administered. In all cases it is important to allay the patient's fears of impotence or sterility, or of the existence of serious organic disease of the parts, and he should be assured of the perfect curability of his disease. Healthy bodily and mental employment should be found, and efforts should be made to distract his thoughts from his sexual organs and all allied subjects; in this way travel will often be found useful. Castration should never be resorted to for this condition.

NEURALGIA OF THE TESTIS.—This affection is characterised by recurrent attacks of severe pain in one or other testicle.

Causes.—Many causes of neuralgia of the testis are known, but in some cases it is quite impossible to assign any cause for the pain. Among constitutional causes, malaria, gout, and anæmia are the best ascertained. Among local causes must be

cited injury to the spermatic cord and nerves, a recent attack of orchitis, obstruction of the vas deferens or duct of the epididymis, a chronic abscess of the testicle, and severe injury to the testicle as by a bullet wound. Malignant disease of the spine affecting the upper lumbar nerves, calculous pyelitis, or the passage of a calculus along the urethra, are conditions which produce true neuralgia of the testicle, evidently through the agency of the spinal cord and nerves.

Pathology.—The pathology of neuralgia of the testicle is not known. In some cases the organ is fuller and plumper than normal, and it is stated to become actually inflamed as the result of neuralgia. Where the pain follows upon injury or inflammation of the part, it may be due to bulbous enlargements of the ends of branches of the spermatic nerves, or to compression of these nerves by contracting cicatricial bands.

Symptoms and Diagnosis.—The affection is characterised by the occurrence of intermittent attacks of severe pain in one testicle (very rarely both), which may be limited to the testicle or shoot up along the spermatic cord. These attacks of pain may recur at regular intervals, or quite irregularly, and they are independent of movement or friction of the testicle. When the pain is severe, the testicle is generally sharply retracted, being drawn quite up to the abdominal ring. Associated with the pain there is sometimes marked local tenderness—a condition of ‘irritability’ of the organ. In some cases the attacks of pain are excited by sexual excitement, particularly if there be obliteration of the duct of the testicle. Neuralgia of the testicle is easily distinguished from irritability of the organ by the paroxysmal character of the pain, and its spontaneous occurrence, apart from contact or friction. In every case a patient attempt to elucidate the cause of the pain must be made.

Treatment.—If there is any reason to suspect the influence of malaria, quinine should be freely administered, and if it fail to relieve, arsenic should be tried; if the patient be anæmic, iron and cod-liver oil are indicated, while if there be any signs of gout or lithæmia, the diet should be carefully regulated and alkalies be freely administered. Very great care should be taken to have the patient’s constitutional condition as healthy as possible. Nothing is definitely known of the value of aconite, belladonna, phosphorus, and other neuralgic medicines administered internally. Locally, the testicles should be suspended, and cold douches,

or the application of equal parts of aconite and belladonna ointment to the scrotum will be found beneficial. The injection of a small quantity of morphia (gr. $\frac{1}{4}$ – $\frac{1}{2}$) into the testicle or into the loose tissues of the cord is the surest means of relieving the pain. Varicocele should be submitted to operation for its radical cure. Counter-irritation of the scrotum or along the cord by iodine or the Spanish fly may be quickly successful in some cases. When the neuralgia owns some distant cause, the treatment must be directed to the cure of that affection—e.g. renal calculus. When, however, all these general and local measures fail, and the pain is severe, and there is reason to think that the cause of the trouble is some condition of the testicle or cord, castration may be performed. This should only be resorted to in very rare instances and under the above conditions, and should never be pressed upon the patient. If the testicle is removed, and the actual cause of the pain is not at the same time removed, the pain recurs in the spermatic cord.

TUMOURS OF THE TESTIS.—*Causes.*—Injuries of the organ, blows and squeezes, are often the apparent starting-point of malignant tumours of the testicle; but in a large number of cases there is no history of previous injury or inflammation, or any circumstances of etiological importance. Dermoid tumours of the testicle are congenital in origin. Age exerts an important influence upon the development of the other forms of new-growth; sarcoma occurs most often before ten years of age, and between the ages of thirty and forty; carcinoma probably never occurs in children, and is most often seen between the ages of thirty-five and forty-five; pure enchondroma of the testicle is met with in young adults.

Pathology.—The commonest tumours of the testicle are sarcoma and carcinoma; of the former, round-cell, spindle-cell, mixed-cell, and lympho-sarcoma or adeno-sarcoma are met with. Carcinoma occurs as encephaloid, and possibly also as scirrhus. The naked-eye appearances of these two classes of tumours may very closely resemble each other. They may each of them occur as soft, pinkish-grey tumours, with patches of yellow and red from fatty degeneration and hæmorrhage. Sarcomata, however, vary much in their appearance; they may be firmer, being traversed by coarse bands of fibrous tissue, or contain nodules or larger masses of pearl-like cartilage. The cartilage may exist in small amount, may form branching pieces

which are believed sometimes to lie in dilated lymphatics, or nearly the entire mass of the tumour may be converted into cartilage, a thin layer of softer material being the only indication of the sarcomatous nature of the tumour. Along with cartilage, myxomatous tissue, and sometimes also striped or unstriped muscle-fibre, may be found.

Cysts are frequently found in these malignant tumours of the testicle. They are more frequent in sarcomata than in carcinomata. In number and size they vary within wide limits—at times only few and small, at other times they form the greater bulk of the tumour; and cystic tumour of the testicle has been described as a distinct variety of new-growth. This term, however, should only be applied to the very rare hydatid and dermoid cysts of the testicle, for in the multiple cystic tumours, sarcomatous tissue, or more rarely carcinoma, is always to be demonstrated between the cysts. The greater number of such cysts are smooth and lined with epithelium, and are developed from the tubules of the rete testis; others of them are irregular, with a flocculent surface, and are formed by the softening of the tumour-tissue or the occurrence of hæmorrhages into it. The former contain pale or variously coloured turbid fluid, and intracystic sarcomatous growths are frequently found in them.

Carcinoma starts in a proliferation of the epithelium lining the seminal tubules; sarcoma, on the other hand, begins in a cellular proliferation between the tubules, which pushes them aside, and remnants of the tubes can often be traced in large sarcomatous growths. These diseases most often start in the body of the testicle, the secreting structure being gradually replaced by the neoplasia, and the epididymis may remain unattacked for a long time. The resisting tunica albuginea at first yields very slowly before the new-growth, but, in actively growing tumours, the soft tissue may fungate through it into the scrotal coverings, and, these becoming involved, ulcerate, a fungus hæmatodes resulting. From the testicle the new-growth may spread up along the cord for a varying distance; but apart from this, owing to the extreme vascularity of these growths, both the spermatic artery and veins are enlarged, and make the cord feel full. Malignant disease is usually unilateral, but sarcoma may attack both testicles. Sarcoma has also been found growing from the visceral layer of the tunica vaginalis,

and surrounding the testicle. Hydrocele, even to a considerable extent, may be added to the enlargement of the testicle itself when attacked with malignant disease.

Secondary growths, whether of sarcoma or carcinoma, are met with in the deep inguinal, iliac, and lumbar glands, and, when the scrotum is affected, the superficial inguinal glands also become infected. The abdominal growths are of the same nature as those in the testicle, and often attain a very large size, and press upon and invade the aorta, vena cava, iliac vessels, or the spine, and may spread to the kidney, liver, and lungs, and from thence to more distant parts. Pure enchondroma, in the form of a rounded or lobulated tumour within a fibrous capsule, and without any softer sarcomatous tissue, is occasionally met with. This form of tumour is not malignant, occurs in young persons, and is of very slow growth. Some cases of so-called fibroma of the testicle are, in reality, spindle-cell sarcomata, which have, to a large extent, developed into fibrous tissue; very rarely pure fibroma, a benign growth, has been met with. Dermoid cysts have been found to contain cartilage and bone, and sometimes an oily fluid which solidifies on cooling. Their origin is variously explained as due to foetal inclusion, to partheno-genesis, or to *hétéropie plastique*.

Symptoms and Diagnosis.—The symptom of a tumour of the testicle is a chronic continuous enlargement of the organ which resists all local and constitutional treatment. It may be first noticed soon after an injury, but more often its origin is quite insidious. It commences in the body of the organ, and quickly obscures the outline of the epididymis, but the ovoid shape of the gland, and its smooth contour, may be long retained. The rapidity of the enlargement varies greatly both in different cases and in the same case at different times. In the one case, the difference depends upon the lower or higher grade of organisation of the neoplasia; in the other, it may be due to the restraining influence of the tunica vaginalis in the early stage, or to some alteration in the nature of the tumour, as when a chondrifying sarcoma ceases to organise into cartilage, and grows as a pure sarcoma. In the early stage the swelling is firm, even hard; but as it grows it may become softer, or, what is very characteristic, of unequal consistence in different parts; and along with this the regularity of the surface is lost. The more malignant tumours may attain an enormous size before death puts an end to their growth.

The scrotal coverings are at first stretched over the included tumour, and dilated veins course under the skin; later on the tumour becomes adherent to and implicates the skin; ulceration then quickly occurs, and allows the malignant growth to fungate, the fungus having all the characters of the well-known fungus hæmatodes; this is now rarely seen, as the organ is usually excised before this stage is reached. The front part of the swelling fluctuates if there is vaginal hydrocele. The cord is full from the increased size of the spermatic vessels, and in many cases it becomes enlarged and indurated from the tumour spreading up along it to the inguinal canal. The growth in the early stage is usually quite or nearly painless, and the characteristic testicular sense is early lost. The lymphatic glands, just above Poupart's ligament, are soon felt enlarged, and, from these, other lumps may be felt running up along the iliac vessels and in front of the lumbar spine; when the scrotum is implicated, the superficial glands of the groin are also enlarged, and in rare cases this is observed before there is any appreciable adhesion of the tumour to its scrotal coverings. With the growth of these glandular tumours there may come on oedema of one or both lower limbs. Enormous growths may occur in the abdomen, and in other parts. The patient at length dies from exhaustion, worn out by pain, discharge, and semi-starvation, or the special effects of certain local secondary deposits.

Tumours of the testicle have to be diagnosed from hydrocele, hæmatocele, chronic orchitis, and tubercular disease. The pyriform shape of the tumour, its translucency and fluctuation, usually at once distinguish *hydrocele*; when, however, the tumour is opaque from thickening of the wall, and the sense of fluctuation is obscure, reliance must be placed upon the detection of the testicle by its special sensibility, and the absence of change in the cord and lymphatic glands. Where doubt exists, it may be cleared up by an exploratory puncture, or, better, an incision. *Hæmatocele* is distinguished from tumour by its sudden onset after injury, often by its fluctuation, and also by the detection of the testicle in the mass by its special sensibility to pressure; the steady persistent growth of a tumour, its unequal consistence, the enlargement of the cord and lymphatic glands, are other points assisting in the diagnosis. Cases do occur, however, in which an exploratory puncture or incision is necessary to render the

diagnosis certain. From *chronic orchitis* a tumour will be distinguished by the absence of the causes of inflammatory enlargements of the testicle; by the persistent, often rapid, enlargement of the organ, in spite of all treatment; by the inequality of the consistence of the tumour in many cases, and by the enlargement of the cord and lymphatic glands. When doubt is entertained, the system may be brought rapidly under the influence of mercury, and if, in spite of this, the growth continue, its malignant nature may be considered certain. *Tubercular disease* will be distinguished from tumour of the testicle by the early and marked swelling of the epididymis, the tendency to softening, and in many cases the presence of tubercle in other organs.

When the tumour has reached a great size, and the scrotal veins are much enlarged, or a mass of the growth fungates through the skin, there should be no difficulty whatever in arriving at a diagnosis. In the more malignant growths, the rapidity and persistency of the enlargement, the early loss of testicular sense, and the impossibility of detecting the testicle in the mass of the tumour, together with enlargement of the cord, are the most important diagnostic signs before glandular infection occurs. In benign tumours, the extreme chronicity of the enlargement, and its hardness or bossy outline, may at once afford ground for a correct diagnosis.

To distinguish between the different varieties of tumour is not always possible; but the following rules are of value. A rapidly-growing tumour, in a child, is certainly sarcomatous. A malignant tumour attacking both testicles is a sarcoma. A malignant tumour, in an adult, may be either sarcoma or carcinoma, but a uniformly rapid growth, with early and marked enlargement of the spermatic cord and lymphatic glands, points to carcinoma. A preliminary period of quiescence or of slow growth, with a sudden accession of activity and very rapid growth, is in favour of a tumour being a chondrosarcoma. A very gradual, painless enlargement of the testicle, forming a smooth ovoid tumour, without enlargement of the cord or lymphatic infection, indicates a cystic sarcoma. Sometimes, one or more of the cysts may project from the surface, and if, on tapping such a tumour mucoid fluid is withdrawn, the diagnosis becomes assured; this form of tumour is generally met with between the ages of twenty and forty. Great hardness of a

steadily-growing tumour occurring after forty years of age, with enlargement of the cord and lymphatic glands, would point to scirrhus. A slowly-growing tumour of great hardness, with a smooth oval or bossy surface, without implication of the cord or glands, and occurring in a man before thirty years of age, is probably a simple enchondroma; such a tumour may attain a very great size. A fibroma cannot be diagnosed with any approach to certainty; like enchondroma, it is of very slow growth and extremely hard, and destitute of all signs of malignancy. A dermoid cyst is to be recognised by the congenital nature of the tumour (if the history be known), by a more or less globular outline, by inequality of consistence—at places being solid, at others fluctuating; if such a tumour be tapped and oily fluid escape, the diagnosis is still more certain. As already noticed, tapping a cystic tumour may lead to the escape of characteristic fluid; in other cases this affords information of the density of the tumour. Both sarcoma and carcinoma bleed very freely; enchondroma and fibroma are much less vascular.

Treatment.—The only treatment of avail, for any case of tumour of the testicle, is removal of the diseased organ. In the rare cases of benign tumours this question presents no difficulty. In malignant tumours, it is most important to perform castration at the earliest possible moment, and certainly before the lymphatic glands are enlarged, or the cord is involved in the disease higher than the external abdominal ring, or the tumour is adherent to the scrotum. The spermatic cord should be divided as high as possible above the disease. In the rare cases of sarcoma affecting both testicles, the two organs should be removed. Only too frequently, when the patient is seen, the cord is enlarged quite up to the internal ring, and secondary deposits are already to be felt in the iliac or lumbar glands. In such cases, the operation cannot be done with any view of curing the patient; but if the tumour of the testicle be a great annoyance to the patient from its bulk or weight, or from the presence of a foul fungating sore, it may be removed simply as a palliative measure. Even when the surgeon operates early, he is only too often disappointed by rapid recurrence of the disease in the stump of the spermatic cord or in the abdominal glands.

But there is no doubt that operation, when performed in suitable cases, affords a chance of cure, and a certainty of immu-

nity from disease for a time, and often for a considerable time. See CASTRATION.

A. PEARCE GOULD.

TESTIS, Injuries of the.—*Causes.*—

The extreme mobility of the testicles protects them from injury, but they are not infrequently contused by blows against the pommel of the saddle in riding, by being struck in fighting, cricket, &c., or by squeezes between the thighs. The testicle is much more rarely wounded; it may be punctured in tapping a hydrocele or hæmatocele, lacerated by a gunshot or other projectile, and, occasionally, self-inflicted wounds of this organ come under the notice of the surgeon.

Pathology.—In contusion of the testicle, blood is often effused between the tunica vaginalis and the tunica albuginea, and up along the cord, and in severe cases this effusion has been found to extend even up to the kidney. Hæmorrhage also occurs into the substance of the organ, and hæmatocele may be superadded. The injury may excite acute inflammation: when less severe, it may be the exciting cause of chronic orchitis, of hydrocele, or of malignant disease. Atrophy of the testicle frequently follows traumatic inflammation of the organ, and severe contusion of the testicles is a recognised method of producing sterility. Division of the tunica albuginea may be followed by protrusion of the seminal tubes, but not to any great extent, unless inflammation be set up. Gunshot wounds of the testicle are very frequently followed by atrophy of the organ.

Symptoms.—Sudden death has been caused by a severe injury to both testicles. The immediate symptoms of contusion of the testicle are a severe pain in the part extending up along the groin to the loin, with acute tenderness and general pallor, nausea, vomiting, and faintness, even to complete syncope. In favourable cases, the constitutional effects are soon recovered from; the testicle and cord remain tender for a few days, and then all symptoms pass away. In other cases, the symptoms of acute orchitis quickly set in, or chronic orchitis or hydrocele may come on at a longer interval, or, still later, a tumour may develop in the testicle.

A wound of the testicle is attended with similar sickening pain and faintness. When made in tapping a hydrocele, blood escapes with the serous fluid or collects subsequently in the tunica vaginalis (see HÆMATOCELE), or a small tender nodule may be detected on the surface of the gland. When impli-

cated in a severe wound of the scrotum, the organ is usually exposed; the tubules may not project at all, or they may bulge outwards in the form of a soft grey nodule.

Treatment.—After a severe contusion, the patient should be put to bed, and the testicle supported on a soft pillow or a broad strip of plaster fastened across the thighs, and an ice-bag applied. When less severe, it may be sufficient to rest for a few hours and to wear subsequently a suspender. When a testicle is wounded with a trocar, the patient should be confined to bed and an ice-bag applied. If the testicle is wounded by a knife, great care should be taken not to draw out any of the tubular structure, but, the part having been carefully cleaned, the edges of the incised tunica albuginea should be united with a continuous suture of fine catgut. Contused and lacerated wounds cannot be thus treated, but the usual surgical rules must be complied with. The surgeon should not remove the injured organ unless it is beyond question that the entire gland is disorganised, and every effort should be made to secure rapid healing of the part. Neuralgic pain is often complained of after gunshot and similar injuries of the testicle. See TESTIS, Diseases of the. A. PEARCE GOULD.

TESTIS, Malpositions of the.—There is no sufficient evidence that a supernumerary testicle has ever been met with—the supposed cases of this deformity being instances in which an encysted hydrocele, or a fatty or fibrous tumour, has been mistaken for a third testicle. One or both testicles may be entirely absent; but this condition can only be proved by dissection, as mere inability to find the organs during life cannot be accepted as evidence of their non-existence. Absence of both testicles (anorchism) is usually associated with other deformities in the sexual apparatus. In cases of ‘retained testis,’ the epididymis and lower end of the vas deferens may be found in the scrotum and separated from the imperfectly descended body of the testicle. The epididymis may also be the only part of the organ developed, occupying its usual position in the scrotum, the body of the organ being entirely absent, or represented by a small pea-like nodule of tissue. Another important deformity is a congenital absence of part or of all, or closure of either end of the vas deferens. This condition does not interfere with the structure of the testicle, which is plump and of its usual size; but of course its secretion does not reach the urethra. The develop-

ment of the testicle, which usually takes place at puberty, may be delayed for a time or fail to occur altogether. The writer believes that this is in some cases (unilateral) associated with and perhaps caused by varicocele; in other instances (bilateral) the subjects of it are generally ill-developed and effeminate in appearance. Absence or non-development of one testicle may be accompanied by hypertrophy of its fellow.

The commonest malposition is that known as *inversion of the testicle*, in which the organ is rotated so that the epididymis is towards the front of the scrotum, and the body of the organ, with the tunica vaginalis, is directed backwards. This condition is easily recognised by the hand, which notices also that the vas deferens is in front of the other constituents of the cord. Inversion is frequently to be seen on one or both sides, and it is of considerable importance in hydrocele, hæmatocele, and epididymitis. In the two former, the testicle will be in front of the fluid in the tunica vaginalis, and may be wounded in the operation of tapping or incising unless its position be previously ascertained. In the latter, the painful swelling may be mistaken for inflammation of the secreting part of the gland: its shape, and the configuration of the back of the organ, as well as the condition of the cord, will lead to a correct diagnosis. A condition of *partial inversion*, in which the epididymis is directed towards the thigh, is very occasionally met with. *Reversion of the testicle* is the name given to the state in which the top of the testicle with the globus major of the epididymis is at the bottom of the scrotum, and the vas deferens comes off from the highest part of the organ.

DELAYED DESCENT OF THE TESTICLE.—Instead of being in the scrotum at birth, the testicle may not descend until months or years afterwards. If the organ do not pass into the scrotum within the first few months after birth, its descent is generally delayed until puberty, accompanying the full development of the organ. In nearly all cases of descent after the age of one year hernia occurs, and in many instances the intestine is adherent to the testicle.

INCOMPLETE DESCENT OF THE TESTICLE.
RETAINED TESTIS.—1. *Etiology.*—Many conditions may interpose to prevent the complete descent of the testicle. Those best known are a fusion of the two testes (synorchism), a long mesorchium, intra-peritoneal adhesions, a weak gubernaculum testis, and a small external abdominal ring. Other alleged causes are shortening of the

vas deferens, large size of the epididymis, and the pressure of a truss causing the gland to become fixed in the iliac fossa or inguinal canal. A testicle, which has completely descended, has been known to be drawn up into the inguinal canal and permanently retained there. See *Retraction of the Testis*.

2. *Pathology*.—The testicle may be of full size, plump, and presenting all its normal appearances when examined microscopically; in the majority of cases it is small and flabby, and it is impossible to draw out the seminal tubules as in a normal testicle. The epididymis may be quite normal, or it may show the same changes as the body of the organ, but to a less degree; but it is sometimes more or less separated from the secreting part of the gland, and may descend into the scrotum while the body of the organ is lodged in the inguinal canal. The epididymis has been found abnormally large. The testicle may be either movable in its serous covering, or more or less firmly fixed by adhesions which tend to increase as attacks of inflammation are repeated. The development of the gland, which should occur at puberty, as a rule does not take place. The vas deferens is generally found of its usual length, and coiled up in the belly; very rarely it is shortened. The scrotum may be quite normal in appearance, but is generally small and undeveloped on the affected side; it may contain only fatty tissue, but in some cases a serous sac is found in it. The serous sac surrounding the testicle may be shut off, but, as a rule, it communicates freely with the peritoneal cavity. Adhesions may be found passing from the testicle to one or more of the adjacent abdominal viscera, or the testicle may be found free in the peritoneal cavity, attached posteriorly by a long mesorchium. A hernia is very commonly associated with 'retention' of a testicle, and in such cases the coil of intestine may be firmly adherent to the top of the gland. The testicle may lodge at any spot between the kidney and its normal position in the scrotum; most often it is retained in the inguinal canal, and its next most common seat is in the iliac fossa, close above Poupart's ligament. In the latter situation it is more protected against injuries of all kinds than in the former, and is therefore less often the seat of inflammation, and the gland is more often plump and well-nourished than in the inguinal canal. As a general rule, a retained testicle is a sterile organ, but to this there are exceptions. The only way of accurately determining this

important point is to examine the secretion of the gland for spermatozoa.

3. *Symptoms, Complications, and Diagnosis*.—There may be no symptoms occasioned by this deformity, and the patient's attention is drawn to his condition only by the empty state and small size of the scrotum, on one or both sides. When the testicle slips freely along the inguinal canal, it is apt to be nipped by the external abdominal ring, with the production of severe pain or of repeated attacks of inflammation. In the more common cases, in which the gland is more fixed in the inguinal canal, its liability to injury leads to attacks of inflammation. The diagnosis will be made by noticing the absence of the testicle from the scrotum, which is usually small or obviously asymmetrical, and by detecting the gland in the inguinal canal or in the iliac fossa, close above Poupart's ligament. The outline of the testicle may be quite distinct and unmistakable, or obscured by the thickening left by attacks of inflammation; the character of the pain caused by manipulation of the part will aid in the identification of the testicle.

The complications of retained testicle are hernia, including strangulated hernia, epididymitis, hydrocele, and malignant disease. The hernia may consist of a knuckle of intestine or a piece of omentum above the testicle, or the protruded viscus may fill the tunica vaginalis, obscuring the testicle, or may even pass on in advance of it into the scrotum, and then great care will be required to recognise the true condition. The presence of a hernia in addition to the retained testicle will be decided by the general characters of the swelling (see GROIN; SCROTAL SWELLINGS), especially by the feel, reducibility, and resonance on percussion of the swelling, and by a gurgle on manipulation. Strangulation of the hernia causes the usual signs of that condition. Acute epididymitis which follows blows or strains, or comes on in connection with inflammation or irritation of the prostatic urethra, is characterised by a very painful tender swelling of the part, with more or less redness of the skin over it, without impulse on coughing, accompanied by fever, and often nausea and constipation—sometimes vomiting. An effusion of blood may occur in the scrotum, and render the diagnosis more difficult. It may be mistaken for a strangulated hernia; but the diagnosis will be made by attention to the history of the case, and by observing the acute local pain and tenderness in epididymitis, with fever but with-

out absolute constipation; in strangulated hernia the pain is less acute, and is generally referred to the umbilicus, local tenderness is less marked, the constipation is absolute, and the general symptoms are those of collapse. For hydrocele around a retained testicle *see* HYDROCELE, Inguinal. Retained testicles are particularly liable to be attacked by malignant disease, owing to their exposure to repeated injuries and attacks of inflammation. For the diagnosis of this condition *see* TESTIS, Diseases of the.

4. *Treatment.*—Where the testicle is lodged deeply in the belly, no special treatment is required. When the testicle is placed close above the internal abdominal ring, a carefully-adjusted truss, which will prevent the descent of intestine without pressing upon the gland, is required. If the testicle be in the inguinal canal, but can be protruded beyond the external abdominal ring, a truss which will press it down and at the same time overcome the tendency to hernia, should be worn: a horseshoe-shaped pad is recommended in such cases. Where the testicle occupies the inguinal canal and can neither be pushed up nor down, a truss should not be worn, as the pressure of the pad upon the testicle excites pain, and may cause inflammation. Acute inflammation must be treated in the usual way (*see* TESTIS, Diseases of the); but when a testicle has been the seat of repeated attacks of inflammation, it should be excised, as it is in all probability functionally useless, as well as inconvenient, and very liable to become the seat of malignant disease. When there is a hernia present, and a truss cannot be worn or fails in its object, an operation should be undertaken to close the neck of the hernial sac and bring the pillars of the ring closer together. At the same time the testicle must be removed from its bed. If the gland is small, flabby, and evidently useless, it should be excised; but if the gland be plump and of good size, and not adherent or otherwise injured by inflammation, it should be freed from its position, and after a cavity has been cut for it in the scrotum, it should be fixed there by catgut sutures, and the superficial wound united in the ordinary way. Should the vas deferens be shortened, this procedure will be impracticable. The wound should be treated aseptically, as much of the success of the operation depends upon obtaining primary union throughout. It should not be undertaken in children under two years of age, nor in elderly persons, nor where the scrotum is so small that it cannot easily

lodge the testicle. *See* HERNIA, Radical Cure of.

When, in operating for strangulated hernia, a retained testicle is exposed, it should be excised. Should the testicle become the seat of malignant disease, excision is to be practised at an early period; but the operation is not so successful as ordinary castration, both on account of its own peculiar dangers, and because it is impracticable to divide the spermatic cord sufficiently high above the disease. If the lumbar glands are infected, as indicated by the presence of a tumour in the iliac fossa, or by pain along the lumbar nerves, or by œdema of the lower limb, the operation should not be performed. When the gland is in the inguinal canal, an oblique incision must be made from over the internal abdominal ring to the root of the scrotum, the external oblique should be divided on a director, and then the testicle is to be freed from its bed, and the cord tied as high up as possible; a drain should be laid in the wound, which is to be then sewn up. The external oblique muscle may be absent over the tumour, which then lies superficially. In the case of malignant tumour of the testicle retained within the belly, the operation of excision may be performed by a free vertical incision immediately over the mass, or by a median incision in the linea alba; experience is not yet sufficient to determine which of these methods is the better.

If consulted as to the propriety of marriage in cases of this deformity, the surgeon must remember that retention of one testicle—the other being sound—is no bar to fruitful marriage. Where both testicles are retained, all the facts bearing on the sexual powers of the patient must be carefully weighed. If the penis be small or ill-formed, or if there be an absence of sexual desire or of sufficient erections, and if with these signs there be an effeminate appearance—absence of beard, a heaping up of fat over the pubes, long, fine, silky pubic hair—marriage should be forbidden. Should there be all the usual signs of virility and the patient is the subject of sexual desire, he should be told that, although capable of sexual intercourse, he is almost certainly sterile; and if on examination of several specimens of the fluid of an emission no spermatozoa are found, the fact of his sterility may be considered as beyond doubt. Under these circumstances, it does not lie with a surgeon to determine the propriety of marriage.

ABNORMAL DESCENT OF TESTICLE.—Instead of passing into the scrotum, the tes-

ticle may, after passing the external ring, slip down towards or into the perineum—*ectopia perinealis, testis in perineo*—or it may take an altogether irregular course and escape from the belly through the crural canal—*ectopia cruralis*. The cause of this deformity lies, probably, in some abnormality in the lower attachment of the gubernaculum testis.

Pathology.—*Ectopia perinealis* is much more common than the crural form. In it the testicle lies either in the furrow between the thigh and the scrotum, or in the anterior part of the perineum in front of the anus and to one side of the median line. The spermatic cord can be traced to it, and the organ presents its usual characters. In *ectopia cruralis*, the testicle may occupy the crural canal, or, passing beyond it, may present in the saphenous opening, forming a superficial tumour in the groin. In these cases there is a tendency to the development of a femoral hernia. The scrotum is usually small on the affected side, and of course empty.

Symptoms, Complications, and Diagnosis.—A testicle in the perineum is much exposed to injury in sitting, riding, &c., and is consequently the seat of repeated attacks of inflammation, and a great source of annoyance to the patient. The association with hernia is the most serious sequel of crural ectopia. The diagnosis will be made by noting the absence of the testicle from its proper position, the non-development of the scrotum (in most cases), and the general characters of the swelling caused by the misplaced organ. When inflamed in the perineum, it might be mistaken for a perineal abscess; in the groin it might be mistaken for a bubo or a strangulated hernia.

Treatment.—*Ectopia perinealis*. In early infancy no treatment is required. If the scrotum is well developed, an attempt should be made to fix the testicle in it, and this is most likely to be successful after two years of age and before puberty, when the child is of an age to admit of the successful application of antiseptic dressings. An incision is to be made over the spermatic cord, which is to be freed, and the testicle is to be drawn up from the perineum, any firm adhesions being divided with the knife. The wound is then to be prolonged into the scrotum, and the testicle fixed in place with catgut stitches. The cavity in the perineum left by the testicle is to be opened behind and a drainage-tube inserted, and then the wound in the groin and scrotum is to be carefully stitched up. Every precaution should be taken to render and

to keep the wound aseptic, and to secure primary union. Should the scrotum be undeveloped it is of no use to attempt this operation, and after the age of puberty the prospect of success is so small as to render the attempt scarcely justifiable. Under these circumstances, the patients can sometimes be relieved by the application of a pad, which pushes aside the testicle into a place where it is less exposed to injury. If this fail, the misplaced organ should be excised.

Ectopia cruralis. If the testicle is reducible into the belly, a truss, as for femoral hernia, should be worn. Where irreducible, a truss with a hollow pad to fit over and protect the testicle should be tried. If this fail to prevent attacks of inflammation or confusion of the gland, or if there is a femoral hernia associated with the misplaced testicle, the gland should be excised, and the neck of the serous sac carefully stitched up, to prevent or to cure a tendency to hernia.

RETRACTION OF THE TESTIS.—**Causes.**—The most frequent cause of retraction of the testicle is calculous disease of the kidney, or the passage of a renal calculus along the ureter. It may also arise from irritation of the urethra, especially of the prostatic portion, and from injury to the groin and pubes. In some cases it has followed acute inflammation of the body of the organ; in others it has been found impossible to assign a cause for the condition.

Pathology.—The retraction is due to spasm of the cremaster muscle; the testicle is usually drawn up to the external abdominal ring, rarely within the inguinal canal, and it is stated that the testicle may even be retracted within the belly. When the retraction is constant and long-continued, the scrotum shrinks and the cord shortens, and adhesions may fix the testicle in its new position. When thus displaced, the testicle is exposed to injury and liable to attacks of inflammation, and possibly it may fail to secrete spermatozoa. When due to renal disease, the retraction occurs on the same side only; in other cases it is often bilateral.

Symptoms and Diagnosis.—The testicle is easily recognised in its new position by its size, shape, peculiar sensibility, and its absence from the scrotum. Its exposure to injury, and the pressure of the thigh upon it in walking and sitting make it a source of pain and annoyance to the patient. The only condition from which it has to be diagnosed is an imperfectly descended testicle; usually the history of the case clears up this point. When, however,

the history is not decisive, the surgeon must carefully notice the condition of the scrotum and the possibility of replacing the testicle in it. When the scrotum on the same side is fairly developed, although empty, and by moderate traction the testicle can be replaced in it, the case is one of retention rather than of non-descent. The occurrence of hernia, which is common in retained testicle, is a mere accidental association with retraction.

Treatment.—When due to renal disease or renal colic, the local irritation must, if possible, be removed, and heat and narcotics are to be used as palliatives. In other cases, all sources of urethral irritation—phimosis, gleet, sexual excess—must, if present, be remedied. Where no such cause of the affection exists, the testicle should be gently manipulated into its proper position several times a day, and, when a pad can be fitted over the inguinal ring above it, a light truss should be worn; cold douches are also recommended; gentle friction over the testicle with ung. belladonnæ has been found useful. Perseverance with these measures is usually successful, when treatment has not been delayed too long.

A. PEARCE GOULD.

TETANUS.—A condition of tonic spasm, in some cases limited to definite groups of muscles, in others affecting almost all the muscles with striated fibres in the body.

A distinction between idiopathic and traumatic tetanus has been very generally accepted, but does not appear to be of any practical importance. When the disease occurs in persons previously in good health, and without any injury, wound, or lesion, it is said to be idiopathic; but when it supervenes in the course of some other ailment, and after any lesion, however trivial, it is regarded as traumatic. The idiopathic form is very seldom met with in this country, but in tropical climates occurs more frequently. Exposure to damp and cold is believed to be a predetermining influence; but as this is also eminently conducive to the development of traumatic tetanus, and as this variety has, according to recorded cases, resulted from most insignificant injuries, such as the sting of a bee, the peck of a sparrow, or the too close paring of a finger nail, the distinction appears to be unnecessary.

Names have been devised to denote forms of tetanus in which definite groups of muscles have been especially attacked. When the muscles of mastication are solely

or chiefly affected, the condition is known as *trismus*. The term is etymologically incorrect, as it is applicable to the grinding and gnashing of the teeth in convulsions, rather than to the tonic spasm of tetanus.

Opisthotonos denotes the predominant contraction of the muscles of the back and neck, by which the body is arched with the convexity forwards. *Emprosthotonos* and *pleurosthotonos* are used to denote respectively curvature of the body with the convexity backwards or to one side. *Orthotonos* signifies the flat and rigid position of the body, when the anterior and posterior muscles are alike and equally contracted. These words are very useless practically, and it is very doubtful whether the forms of the disease denoted by the terms *emprosthotonos* and *pleurosthotonos* ever occur.

Some confusion may also be caused by the usurpation of late years by physiologists of the word tetanus to denote the normal contraction of striated muscular fibre, with the exception of that of the heart.

Tetanus has also been classified as *acute* and *chronic*; but, as time is the only test, the distinction is of no use to a surgeon who may be consulted at the commencement of the affection.

Practical surgery has to deal with traumatic tetanus occurring after wounds or injuries, maliciously or accidentally inflicted, or after operations. The liability to tetanus has no relation to the severity of the injury. It has occurred after the extraction of a tooth or the ligature of a pile, as well as after the amputation of a limb or the ligature of a large artery in its continuity. The popular belief, that wounds of the hands or fingers are especially liable to result in tetanus, is not corroborated by the evidence of statistics.

There are no definite premonitory symptoms. Usually the first indication is that the patient, who has previously been progressing favourably, awakens from sleep in the morning, in many cases for the last time in this world, with a sensation of stiffness in the muscles of the sides and back of the neck, by which movement of the head is rendered painful or inconvenient. The patient generally regards it as 'stiff neck,' caused by exposure to a draught of cold air. It is sometimes so slight as not to excite complaint or even notice from the patient, and is only discovered by the surgeon on examination and inquiry, when his attention has been directed to the nature of the case by other symptoms. The muscles of the face and lower jaw are next attacked. If the contraction of the orbicularis oris

muscle predominates, the lips will be closely pressed together; more usually they are drawn asunder, so as to produce the 'risus sardonicus' by the action of the elevators and depressors of the lips. The elevators of the lower jaw are constantly and characteristically contracted. Of these, the masseters are most accessible to observation, and feel like rigid, unyielding bands. They are sometimes sensitive on pressure. The contraction is not at first complete, and the patient can voluntarily increase it so as to press the jaws more closely together, and can then relax this increased contraction, but he is unable to overcome the tonic spasm.

As the disease progresses, the contraction usually becomes complete, and justifies the popular appellation of 'lockjaw.' The muscles of the fauces and pharynx are very frequently spasmodically contracted, so that the patient complains of sore-throat, and deglutition is either difficult or impossible. The muscles of the trunk are next involved. The walls of the thorax are immovable, and the respiration is shallow and frequent. Pain is felt at the pit of the stomach, from spasm of the diaphragm. The abdomen is flat and unyielding, from spasm of the abdominal muscles; and opisthotonos frequently results from predominant contraction of the muscles of the back and neck. When the lower extremities are affected they are rigidly extended, and the feet are strongly flexed. The upper extremities may also become rigid, but the muscles which move the fingers frequently, or, according to some observers, always, are not affected. The pulse is frequent and feeble, and the skin is bathed in profuse perspiration. If the temperature be previously normal, it will not be raised in this stage of the disease; but if, from other conditions, it be abnormally high, the onset of tetanus will not cause it to fall. There is usually constipation, partly from spasm of the sphincters of the bowel, and partly from the condition of the abdominal muscles. The profuse perspiration, and the inability in many cases to swallow fluids, will naturally diminish the excretion of urine, but there may be retention of this diminished quantity, from spasm of the compressor urethræ and abdominal muscles. Examination should therefore always be made of the condition of the bladder, and a catheter, if necessary, be introduced.

There is no cerebral symptom. The patient continues intelligent throughout the course of the disease, and not infrequently complains of hunger, and deplors his in-

ability to swallow. In many cases, death ensues at this stage from failure of the heart or from respiratory spasm. If not, symptoms of greatly increased reflex excitability appear. Violent convulsive exacerbations are produced by the lightest touch, or even by a current of air or a sudden noise. In these convulsions the tongue may be bitten or muscles ruptured. Sometimes, even bones have been fractured and dislocations produced. In this stage the temperature rises very considerably, and if death now ensues, the temperature has been found to increase appreciably for some time after death. If the patient still survive, these exacerbations may diminish in force and frequency, and at last cease altogether. The tonic spasm, which has hitherto been persistent, then begins to yield, and finally disappears. But so long as any trace of it continues, the patient is in great danger of a relapse. In many cases, however, death occurs from respiratory spasm during a convulsive attack. Sleeplessness is a characteristic feature in tetanus. If sleep can be induced by narcotics the tonic spasm is said to relax, and to instantaneously reappear when the patient awakes.

This is a general description of typical tetanus, but in individual cases there may be many variations. In infants, the spasm is usually limited to the elevators of the lower jaw, and thus constitutes the trismus neonatorum, popularly called 'nine-day fits,' from the time after birth at which the disease generally commences. In adults trismus alone is rare; it is usually associated with more or less contraction of the muscles of the neck and trunk. The extremities are sometimes not affected, and in some cases deglutition is only slightly, or not at all, impaired.

The *prognosis* in tetanus is always unfavourable. The mortality is less in idiopathic than in traumatic cases. But in each individual case, at the outset, the surgeon must, while endeavouring to prevent, yet expect a fatal result. In traumatic cases, the shorter the interval between the primary lesion and the appearance of tetanus, the more probably will death result. The duration of the disease is a very important element. Hippocrates observed that survival beyond the fourth day was a very favourable indication, and this has been corroborated by more modern experience. Death has, however, occurred thirty-nine days after the commencement of the attack. No correct inference can be formed from the apparent mildness of the symptoms. The writer had under his charge three cases of tetanus

in the year 1884, which all ended fatally, although the symptoms in each case were not severe.

The *diagnosis* does not present any difficulty. Sometimes inability to open the mouth, from some local inflammation, has been mistaken for trismus. In doubtful cases, a finger should be introduced between the teeth and cheek and the condition of the jaws explored; or, if necessary, an anæsthetic should be administered, and the cavity of the mouth and fauces examined. The existence of cerebral symptoms, which are always absent in tetanus, will sufficiently distinguish cerebro-spinal meningitis. Hydrophobia, in some respects, greatly resembles tetanus. The absence of trismus, and the complete intermissions between the convulsions, will prevent any doubt as to the nature of the case. The same distinctions apply to the tetanic convulsions produced by poisonous doses of strychnia. Hysterical trismus may be distinguished by the history of the patient and by the progress of the case.

The *treatment* of tetanus is very unsatisfactory. It happily occurs so infrequently in civil practice that the experience of any individual surgeon is necessarily limited. The literature of the subject is abundant, but as it includes cases which were certainly not tetanus, the statistics as to results of treatment are not of much value. In traumatic tetanus the wound or injury should be thoroughly explored, so as, if possible, to remove any source of peripheral irritation. The patient should be isolated, and complete quietude maintained. If deglutition be possible, easily assimilable nutriment, alcohol, and sedatives, of which chloral hydrate is perhaps the best, should be freely administered. If deglutition be impossible, rectal injections may be tried. But if these prove impracticable, then brandy and narcotics may be injected hypodermically. In the three cases above referred to, which have been recently under the writer's charge, calabar bean was tried with the first; this apparently relieved the respiratory spasm, but death ensued within twenty-four hours. To the second case bromide of potassium was given in large doses. The pharyngeal spasm relaxed so that the patient could swallow fluids, but death occurred on the third day. In the third case, commencing convulsions of the muscles of mastication yielded to large and repeated doses of chloral hydrate, and the patient felt generally relieved, but death occurred on the third day.

Cold baths were formerly advocated, but are no longer used. The result in one

instance is worthy of notice. The patient was, at his own request, immersed in cold water. All symptoms at once ceased. He was instantaneously removed from the bath, but he was dead. Warm baths have been tried, but there are obvious difficulties in using them for cases of general tetanus, and the result, when they have been employed, is not encouraging. The constant application of ice to the spine, by means of Chapman's bags, has not proved of much benefit. Nicotine has been successfully used in some cases, but has failed in others. If tried, it should be given in doses of from one to two drops every two hours, and the effect on the action of the heart carefully observed. According to recorded cases, almost every drug in the Pharmacopœia has been tried without success. If benefit resulted in one or two cases, the hopes thus excited were soon disappointed by failure in other cases. Much was once expected from curare, but experience has not confirmed the expectations. Electro-therapeutics may possibly prove serviceable when our knowledge has been enlarged by greater experience in their application. Nerve-section and nerve-stretching have been also tried, but with disappointing results. In a few cases amputation has been successful, but this measure should only be adopted when there is distinct evidence of peripheral irritation from some otherwise irremediable cause, such as an irreducible dislocation.

The *pathology* of tetanus is very obscure. The considerable diminution in the number of cases of trismus neonatorum in the Dublin Lying-in Hospital when improved hygienic conditions were established, the experience of army surgeons in time of war, and the occurrence of so-called idiopathic tetanus, seem to prove clearly that unhealthy surrounding conditions may cause this disease. It is possible that under such conditions some poison may be engendered in, or absorbed by, the system, which may act specifically on the medulla oblongata and spinal cord. On the other hand, the great numerical preponderance of cases of traumatic tetanus, and the few cases where relief has resulted from the removal of some peripheral irritation, seem to indicate that some as yet unknown condition of a peripheral nerve may be the exciting cause. But it is inexplicable why one patient, for whom a pile may have been ligatured, should develop tetanus, while thousands of other patients, treated in a similar manner, should be free from such a result; or, why the injury of a peripheral nerve should primarily affect the centres of the fifth,

seventh, and eleventh cranial nerves. In a few cases the characteristic spasm has commenced in the muscles at the seat of injury. But this is a very rare and exceptional event. Post-mortem examinations have not advanced our knowledge of the subject. Macroscopically, congestion of the thoracic viscera, of the cerebro-spinal membranes, and of the grey matter of the brain and spinal cord, is discovered in all cases. Sometimes, portions of the spinal cord are soft or even diffuent. Microscopically, localised degeneration in both the grey and white substances of the brain and spinal cord, and granular exudations have been found in some cases. These are, however, probably only secondary results of some as yet unknown primary condition.

JEREMIAH MCCARTHY.

THECAL ABSCESS. See WHITLOW.

THERMO-CAUTERY. See CAUTERY.

THIGH, Amputation of the.—The alleged merits as well as defects of the 'circular' and 'flap' methods of amputation are more conspicuous in this group of operations than in any other, the advocates and opponents of each of the procedures alluded to having urged their arguments chiefly in reference to thigh amputations.

The advocates for the old, and what may be termed the classical, method—the *circular*—maintain that there is diminished risk to the patient, from the shock of the operation being less, that the area of the wound is necessarily not so great in extent, and that there is less danger, owing to the way the vessels are divided, of phlebotic inflammation. The supporters of flap operations, on the other hand, hold that there is less danger of a conical stump resulting, greater facility in getting sufficient covering for the bone, greater shape-ness of stump, and one better adapted for the subsequent adjustment of prothetic mechanical appliances. Again, the cicatrix not being on the face of the stump, the inconvenience and pain to the patient produced by pressure on it are avoided. In order to secure a more ample covering than at times is obtained by the ordinary circular method, the modification of Syme already discussed in speaking of amputations of the leg is to be recommended—making, namely, an incision involving skin, fat, and fascia only, somewhat lunated in form, both on the anterior as well as posterior aspects of the limb, and combining that with circular division of the muscles.

The principles to follow in performing thigh amputations by the ordinary circular method, differ in no respect from those already indicated in describing amputation of the arm, and the other amputations in which the circular method is applicable.

Teale's rectangular method is, in the writer's opinion, specially applicable to thigh amputation, more particularly in its lower third. The measurements to be taken previously to the operation are: first, the circumference of the limb. Half of this will correspond to the length of the anterior flap as well as to its width, and one-fourth of the length of the anterior flap, or one-eighth of the circumference, will give that of the posterior flap. In making these rectangular flaps, care should be taken that the incisions in the first instance should not involve more than the integument, fat, and fascia. On making the deeper incisions, the divided edge of the integument, which has to a certain extent contracted and retracted, should be accurately followed. If this precaution be not taken, it will be found on adjusting the flaps that there will be considerable bulging or protrusion of the muscular tissues through the edges of the wound, which may materially interfere with a prompt and satisfactory union of it. The advantages of the operation are that the cicatrix is well drawn up behind; that all fluids which may accumulate find a ready exit from the wound, when the flaps are adjusted, being on the posterior aspect of the limb; that the flaps afford an ample covering for the bone; that there is diminished danger of the formation of a conical stump, and that the principal nerves and vessels, being for the most part in the posterior flap, are removed from the effects of pressure. The modifications of Sir Joseph Lister and Mr. Wharton have been already discussed. See AMPUTATIONS.

The other *flap amputations* of the thigh deserving of notice are Sédillot's, by a long anterior and no posterior flap; Spence's, which is analogous if not identical with that of O'Halloran and Benjamin Bell, and in which there are a long anterior oval and a short posterior flap. The length of the flap in Spence's operation should equal the diameter of the limb, and the breadth of its base be one half of the circumference. According to Sédillot, the breadth of the base should be even more. Care should be taken to avoid having the flaps too thick, which can be accomplished by oblique division of the muscles. Luke's amputation is done by antero-posterior flaps of equal length. In order to obtain this

with accuracy, he recommended the posterior flap to be made in the first instance, and subsequently on its retracting—which the posterior tissues do to a greater extent than the anterior—to form the anterior, making it of the same length as the posterior after its retraction. When the two flaps are brought together they should remain in accurate apposition, and the chances of a gaping wound subsequently occurring from the retraction above alluded to are largely diminished. Both flaps are made by transfixion.

A bilateral-flap method has been recommended by Vermales, both flaps being made by transfixion, and a somewhat similar method has been proposed by Von Langenbeck. In the latter procedure, however, the flaps are cut from without inwards. In both operations there is the danger of bone-protrusion, from the tendency of it to be tilted forwards through the wound. In consequence, neither operation finds, as a rule, much favour with operating surgeons.

For the control of hæmorrhage during the operation, Esmarch's elastic bandage will, in the great majority of cases, be found the most efficient method to employ. Elevation of the limb for a short time previously to the application of the bandage is to be recommended, as it removes or diminishes the necessity for any very firm pressure of the elastic bandage, which is to be avoided.

As regards the mortality of thigh amputation, there is no operation of the kind, excepting, perhaps, amputation at the hip-joint, which illustrates so signally the benefits that are to be derived from the employment of strict antiseptic precautions during and subsequent to the operation. Formerly, at no very remote date, septic complications played the main rôle in producing a mortality so high—upwards of 60 per cent.—as to justify the gravest apprehensions on the part of the operator. Now, however, when a rigid system of Listerian asepticism is employed, the surgeon can, in the great majority of instances, undertake the operation with a pleasing confidence as to a satisfactory result being obtained, which was wholly unknown to the surgeons of the pre-aseptic era.

Although some surgical operators of intelligence and experience are of opinion that the shock is greater after 'flap' than 'circular' amputations, and that, therefore, the latter method should be selected when the patient is in early childhood, or in cases of extreme debility or exhaustion from protracted suffering, hæmorrhage, or long-

continued profuse suppuration, still the writer's experience fails to afford him evidence that there is any solid foundation or reason for holding such a view. On the contrary, he is disposed to think that, in connection with amputation of the thigh especially, the 'flap' methods, notably those of Teale, Sédillot, or Spence, or, if the case will admit of a low femoral section, the 'supra-condyloid' method, are not attended with greater shock than the 'circular' or any of its modifications. See KNEE-JOINT, Amputations at the. They have, among other merits, the undoubted one of resulting in greater shapeliness of stump, with the cicatrix on its posterior aspect and thus relieved from the trouble that often attends pressure on it, and in every way better suited to the subsequent adaptation of mechanical appliances.

WILLIAM STOKES.

THIGH AND LEG, Diagnosis of Affections of the.—For the diagnosis of affections of the lower extremity it is of great importance to carefully compare the two limbs. Measurement from the anterior superior iliac spines to the internal or external malleolus can only be relied on as correct, when the spines are at the same level, and the limbs are placed in a symmetrical position as regards a vertical line through the umbilicus and symphysis pubis. If any swelling of the limb causes a deviation of the tape, a T square should be employed.

It is often necessary to ascertain the respective lengths of the femur and tibia. The most prominent point of the internal condyle of the femur and the inner articular edge of the tuberosity of the tibia should be marked, previously to taking the measurement. For the diagnostic importance of the relative positions of the trochanter and the head of the femur, reference must be made to HIP-DISEASE.

The diagnosis of a *femoral hernia* ordinarily presents no difficulty, and the position of its neck below Poupart's ligament and external to the pubic spine will at once distinguish it from an inguinal hernia. An irreducible omental femoral hernia, especially if the omentum be inflamed, is, however, often difficult to distinguish from a glandular swelling in the crural region. Impulse on coughing, and some variation in the size of the swelling on manipulation, together with the history of the case, will usually determine its nature. When strangulation exists, the seat of greatest tenderness will be at the neck of the sac, and not

over the general body of the swelling, as in an inflamed gland; but a most careful examination is necessary, and sometimes an exploratory incision will alone clear up the diagnosis. See GROIN.

An inflammatory enlargement of a *gland* or glands in the crural region sometimes occurs without any manifest cause.

An *acute abscess* in the upper part of the thigh presents no special difficulty in its recognition; but a chronic fluctuating swelling, or one that has appeared suddenly, unattended by active inflammatory symptoms, must be examined with special reference to its possible abdominal origin.

A *psaos abscess* often presents on the inner side of the thigh, at a lower point than a femoral hernia. There is an impulse on coughing, and the swelling is less tense when the legs are raised. An examination with the abdominal walls relaxed will generally discover a fluctuating swelling above Poupart's ligament, communicating with that in the thigh by a prolongation, which is first external to and then behind the femoral vessels. Such an abscess generally arises from vertebral caries, and a most careful examination of the back must be made before eliminating vertebral disease as a cause. See Psoas Abscess.

An *abscess* situated just below the outer part of Poupart's ligament, which communicates with a swelling in the *iliac* region, may depend on hip-disease or pelvic bone mischief, or may have descended into the thigh from the abdomen, and be an extension of a subperitoneal or subfascial iliac abscess. The kidney, cæcal region, and pelvic organs must be examined. As an exceptional condition, an empyema may travel downwards and present in this situation.

A *gaseous* or *tympanitic abscess* is occasionally met with in the upper part of the thigh, and is either in connection with a femoral hernia; or the abscess has descended into the thigh from above Poupart's ligament, and is in close connection with bowel at its origin.

A fluctuating rounded swelling situated deeply in the groin under the *psaos tendon*, without impulse, and with entire absence of hip-symptoms, except perhaps some discomfort on extending the leg, is very likely to be a distension of the normal *bursa* in that situation. Occasionally, the communication with the joint is open, and the bursal contents can be partially emptied into the joint.

A chronic fluctuating swelling on the outer side of the thigh over the great tro-

chanter may be an *abscess*, or a distended condition of the multilocular *bursa* under the insertion of the *gluteus maximus*. In the latter case pressure will often permit of small seed-like bodies being felt, and the displacement of the fluid gives a peculiar and characteristic sensation to the fingers. An abscess in this situation may depend on hip-disease, or on disease of the trochanter, or be a chronic subfascial suppuration. A gluteal abscess not infrequently presents at the back part of the thigh near the trochanter, and may therefore be in connection with pelvic or vertebral bone-affectation. See GLUTEAL REGION.

Acute bone-inflammation near the articular ends of the femur is not uncommon in young subjects. The fever and general constitutional disturbance are well-marked, and there are pain and tenderness on pressure over the part of the bone affected. Rapid inflammatory infiltration of the soft parts and formation of abscess occur. Deep abscess in the front of the lower part of the thigh, when acute may, however, be secondary to suppuration of the knee-joint, the pus having perforated the upper synovial pouch, and become diffused under the muscles. Pressure over the abscess would then probably cause the joint to refill.

Where the femoral artery is superficially placed, an *aneurismal dilatation* will readily be recognised. Any fluid or soft swelling placed over the femoral would not possess the characteristic expansile pulsation. A pulsating soft sarcoma of bone might push the artery forwards, and diminish by pressure the pulse in the vessels at the ankle. The swelling, however, would have fixed deep connections, and the bone would be felt to be enlarged. No alteration in the size or tension of the swelling would be noticed, when pressure was made on the vessel above or below its apparent expansion. The appearance of similar pulsating tumours in other parts would of course greatly simplify the diagnosis. A glandular or other non-pulsating tumour, placed over or surrounding the artery, would not be so likely to be taken for an aneurism, since expansile pulsation and bruit would be absent or ill-defined.

An aneurism in *Hunter's canal*, which had undergone consolidation, might easily, with a hasty examination and an absence of correct history, be mistaken for a tumour.

It is frequently difficult to determine the nature of a deep-seated soft swelling in the thigh. Care must be taken, in testing for fluctuation, to apply the fingers in the direction of the muscular fibres, and not across

them. A soft tumour, especially a *fatty* one deeply placed, will sometimes deceive the most experienced surgeon, and an exploratory puncture or incision will alone decide the question of the presence of fluid. If there be reason to suspect the presence of a *cavernous angioma*, circular pressure should be made round the upper part of the thigh, and the patient examined in the erect position; such a swelling would then become much more tense and prominent. The vasti and other muscles of the thigh may be affected by *syphilitic infiltrations*; in cases of doubt, the administration of iodide of potassium will often assist the diagnosis.

The lower end of the femur may be considerably enlarged by a central *necrosis*; as a rule sinuses are present, and there is a history of a previous inflammatory attack.

A *myeloid* tumour may cause great expansion of the bone, without any involvement of the cartilage or joint. At an early stage of its growth, such a tumour might be confounded with a chronic bone-abscess or some inflammatory enlargement, more especially as the patient in either case is usually young. A uniform expansion of the end of the bone, not attended by much pain or tenderness, and not interfering greatly with the movements of the joint, and with a recent history, will, in all probability, be a central sarcoma. Pulsation, if present, would make the probability greater; but the diagnosis must be made clear by a careful exploratory operation.

A *periosteal sarcoma* of the lower end of the femur does not end so abruptly as a central tumour; the growth, as a rule, more rapidly increases in size, and feels rather elastic than fluctuating. If the growth be very soft or cystic, fluctuation may be present; but an exploratory puncture will yield either blood or evidences of broken-down growth. Patients occasionally give a history of recent injury, and the swelling may at first simulate a blood-effusion or inflammatory thickening of the upper synovial pouch, but a very short observation of the progress of such a case will excite the surgeon's suspicions of its true character.

THE KNEE.—In any case of doubtful *fracture* near the knee, an examination under an anæsthetic should be made, and it should be ascertained if there be movement between the two condyles of the femur. A displacement at the knee will generally be found associated with a fracture of one of the condyles of the femur, or with an oblique fracture of the head of the tibia.

A recent displacement or fracture of the *patella* is, as a rule, sufficiently evident, but

if much swelling be present, or if the fragments remain in position, it might be overlooked. Pain on pressure over the bone would direct attention to the part. A careful comparison of the two knees must be made, any irregularity of the patella noticed, and the different parts of the bone tested for mobility and crepitus.

The condition of the quadriceps tendon and of the ligamentum patellæ must be determined. A *rupture* of either of these structures would occasion a considerable gap, which would be recognised by the finger. With a complete rupture of the ligamentum patellæ, the patella would be displaced upwards.

After a sprain of the knee some effusion into the joint may be expected, and tenderness and pain about the internal or external lateral ligaments. A displacement of one (usually the internal) of the *semilunar cartilages*, if unreduced, would give rise to a swelling corresponding to the margin of the cartilage, if the displacement be extra-articular; or to a depression, when, as more rarely happens, the cartilage is luxated inwards or centrally. Complete and free flexion and extension of the joint would only be possible when the displacement was reduced, and the patient would be conscious of the slipping of the cartilage back to its normal position, and of the relief at once afforded. The displacement is apt to recur on slight provocation, but is generally first caused by a severe and sudden strain. The impaction of a *loose body* between the articular surfaces occurs generally during the ordinary movements of the joint, and the patient is usually conscious that he has such a body moving about in his joint. It sometimes requires patient and repeated search by the surgeon before one of these movable bodies can be actually fixed under the finger. The distress and pain occasioned by the locking of the joint, from a foreign body getting between the bones, is often greater than that arising from a partial luxation of a semilunar cartilage.

Under ordinary circumstances, there is no difficulty in recognising an *effusion of fluid* into the knee-joint. Occasionally, some of the fluid can be pressed out of the joint into a hernial pouch or communicating bursa in the popliteal space. A pulpy thickening of the synovial membrane, from chronic inflammation or from gummatous infiltration, may give rise to a false sense of fluctuation; but the feeling of fluctuation is always indistinct, and limited to certain parts of the joint.

Periarticular swelling and joint-effusion can hardly be mistaken for one another, but occasionally the two conditions may be present; for example, after an injury there may be an effusion into the joint, associated with blood-extravasation around an inflammation of the prepatellar bursa, or peribursal suppuration.

A rounded fluctuating swelling situate above the patella, but with no fluid in the general cavity of the joint, is probably an effusion into the *suprapatellar bursa*. When there is no fluid in the knee-joint, and the ligamentum patella is prominent owing to a fluctuating swelling beneath it, and especially when the swelling is made more prominent on either side of the ligament by pressure on the same, an effusion into the *infrapatellar bursa* may be diagnosed.

The line of junction of the epiphyses at the knee is a favourite position for *exostoses*. They may be multiple, are usually pedunculated, and often have a small bursa over each of them. In cases of genu valgum and varum, an examination of the fascial and tendinous structures round the knee must be made. The leg should be fully flexed, in order to determine how much of the deformity depends on the articular ends of the femur or tibia, or both.

The examination of a knee-joint for *arthritis* must be conducted on the same general principles as in other joints, and a careful comparison made with the opposite leg. It is of great importance to examine the articular ends of the femur and tibia, and any enlargement or tenderness on superficial or deep pressure should be noted. In young subjects, the epiphysal junctions should receive special attention, and, in all cases, the size and position of the patella and the articular margins of the bones made out. The examination must be made in every position of the joint, and the mobility and effects produced by bringing different parts of the articulating surfaces into contact tested. In many cases, valuable information is obtained by relative measurement of the two limbs. Some elongation of femur or tibia is not infrequently present, when there has been a chronic inflammatory affection of their articular ends.

In all cases of progressive, destructive arthritis of the knee there is a tendency for the limb to assume a flexed position at the joint, and for the tibia to drop backwards and to be rotated somewhat outwards. See KNEE-JOINT, Diseases of the.

A *popliteal aneurism* can hardly be overlooked when the symptoms are at all marked, but the patient may not be conscious of any tumour behind the knee, and apply to the surgeon for some swelling of the foot, or for nerve-pain down the leg. Unless there be an obvious cause for such a condition, the surgeon should examine carefully the popliteal space, and more especially if the patient be a man from thirty to fifty years of age. See POPLITEAL ANEURISM.

When seen for the first time, and in the absence of a correct history, a *consolidated aneurism* might easily be mistaken for a solid tumour pressing on the artery and causing diminution of the pulse in the vessels in the leg. If the sac has inflamed, and suppuration takes place round it, the diagnosis in the absence of pulsation would be still more obscure. A solid or bursal tumour can generally, when the leg is flexed, be shifted away from the vessel, and any communicated pulsation will then at once cease. An abscess situated between the artery and the bone will displace the vessel towards the surface, but the pulsation will only be evident in the line of the artery, and expansile pulsation and bruit will be absent, and in most cases there would be evidence both constitutionally and locally of the presence of pus. A pulsatile sarcoma springing from the popliteal aspect of the femur might closely simulate an aneurism. A few of the points in the diagnosis of such a case have been mentioned in reference to femoral aneurism.

In the absence of any history of previous swelling, it might be difficult to distinguish between a sudden *rupture* of the popliteal artery and the traumatic rupture of an aneurism, since in both cases there would be great tension from effused blood and interference with the circulation of the leg. A rupture of the artery can only occur when the violence is considerable or the vessel diseased.

An effusion into the bursa between the semi-membranosus and the gastrocnemius can be recognised by its position on the inner side of the popliteal space. However tense such a swelling may be when the leg is extended, its limits can readily be felt when the leg is flexed. A communication with the joint can sometimes be demonstrated by squeezing some of the fluid out of the sac. See POPLITEAL SPACE.

THE LEG.—There are two *fractures* of the leg which are likely to be overlooked—namely, a transverse fracture of the tibia without displacement, and a fracture of the

fibula where the bone lies under cover of the muscles. The transverse fracture of the tibia generally occurs in a young subject. Tenderness over the seat of fracture is always present; the patient might be able to stand, but would have pain referred to the seat of injury. Mobility and crepitus would be difficult to elicit, unless the examination was made under an anæsthetic.

Not infrequently, the only evidence of a fracture of the fibula will be the fixed pain and tenderness over the seat of fracture, and pain referred to the same point when pressure is made on either end of the bone: the patient may be able to walk, but will complain of pain at the seat of fracture. Any irregularity of the bone must be carefully felt for, and the rebound of the fibula, when pressed against the tibia, tested by comparison with the sound leg.

If, during some muscular effort, a patient has felt a sudden severe pain in the calf and a sensation of something snapping, and on examination it is found that voluntary efforts to extend the foot give pain, and that there is some tenderness and ecchymosis of the calf, then, if the tendo Achillis be intact, the diagnosis of a *ruptured plantaris* may be made.

The upper end of the tibia is a common situation for *myeloid tumour*. The bone may, however, be considerably expanded by abscess, and, in some cases, the diagnosis can only be made by an exploratory operation. As the tibia is so superficially placed, acute and chronic bone-affections can for the most part be readily detected; but occasionally, when the disease is limited to the posterior part of the bone, the symptoms may be at first obscure.

In the *acute diffused periostitis* of the tibia of young persons, the inflammatory swelling and redness of the soft parts covering the bone somewhat resemble an erysipelatous attack; but the extreme tenderness on pressure, and the limitation of the redness and cedema to the shaft of the bone, render any mistake in the diagnosis almost impossible. See PERIOSTITIS.

Erythema nodosum on its first appearance occasionally simulates a circumscribed periostitis of the tibia. The affection is usually symmetrical, and sometimes to be found on the arms; but patches of erythema can generally be found away from the bone, and those situate over the bone are movable with the skin, and the general course of the affection is characteristic. See ERYTHEMA.

For the diagnosis of ulcers of the leg, see ULCERS. It must be remembered that a syphilitic ulcer may occur on the lower

part of the leg, and on a leg predisposed by the condition of the veins to simple ulceration. Rapid extension of an ulcer of the leg, without obvious cause (such as maltreatment), makes its syphilitic origin probable.

BERNARD PITTS.

THOMAS'S HIP-SPLINT consists of a piece of malleable iron, reaching from the lower angle of the scapula to just below the calf, and having three cross-pieces of the same metal attached to it. The first one is placed at the upper end of the splint and reaches partially round the chest, but more on the sound side than the other, being completed by a padded strap and buckle; the middle one is placed just below the nates, and the third one at the lower end of the splint. The vertical bar should lie between the trochanter and the tuber ischii, and below this over the middle line of the thigh or leg; the splint is supported by shoulder-straps, and is bandaged to the pelvis and to the limb between the lower two hoops; the foot is raised from the ground by a patten fitted to the boot of the sound leg, and the patient is taught to walk on that leg with the aid of crutches. The malleability of the splint allows of its being moulded to the shape of the limb, and of being altered as the deformity is rectified. See HIP-DISEASE.

It is, however, important that the splint be not made to fit the deformity accurately, for that would assist in maintaining it. In hip-joint disease, when the leg is brought straight down on to the bed, the lumbar spine arches forwards, and, if the splint were made to fit that arched condition of the spine, the deformity would be perpetuated. The portion of the splint which reaches from the buttock to the angle of the scapula should be nearly straight, for although it will not fit accurately when first applied, the spine will soon accommodate itself to the splint by gradual extension taking place at the hip-joint, and thus the deformity will be remedied.

BILTON POLLARD.

THOMAS'S KNEE-SPLINT is composed of two stout metal rods, which are fixed above to a well-padded and obliquely-placed ovoid ring, and below to a patten. When applied, the ovoid ring should rest against the tuber ischii on one side, and just below the crista ili on the other, and the patten should be so far below the foot that, when the latter is extended, the toes cannot reach to the level of it. When the patient gets up, the splint is supported by a

strap over the opposite shoulder, and, when he walks on the splint, a patten must be fitted to the boot of the other foot in order to equalise the length of the limbs.

The success of this splint, as a means of fixing the knee, depends altogether on its being properly applied. Immobility of the limb must be secured in the longitudinal, lateral, and antero-posterior directions. Two strips of strapping, about three inches wide, and long enough to reach from the head of the tibia to twelve inches beyond the sole of the foot, should be prepared and fixed along each side of the leg; they should be secured by another strip, about an inch wide, wound spirally round the leg, and by a flannel bandage applied over all from the ankle to the knee. The splint should next be put on and pressed firmly upwards, so that the collar at the upper end rests against the tuber ischii, and then the free ends of the pieces of strapping above described should be fixed to the ring at the lower end of the splint; by this means longitudinal displacement is checked. Transverse and antero-posterior displacement must be prevented by applying transverse strips of strapping round the limb and the splint, opposite the middle of the thigh and the middle of the leg, in the following manner: A piece of strapping, about three inches wide, should be fixed round one of the lateral bars of the splint opposite the calf of the leg; the strapping should then be carried beneath the leg and round between it and the opposite longitudinal bar of the splint, and returned to the bar from which it started. It should next be carried beneath the limb to the opposite bar, round which it should be passed at a slightly higher or lower level than on its fellow; the strapping should finally be carried round the leg, between it and the bar from which the strapping originally started, and should be finished off by encircling the entire splint. The piece of strapping for the thigh should be applied in a similar manner, but it should start from the opposite bar. A third piece of strapping should be carried from bar to bar behind the limb, opposite the popliteal space; and a flannel bandage should be put on over all, from just above the ankle to the groin.

BILTON POLLARD.

THORACENTESIS. See PARACENTESIS THORACIS.

THORACIC DUCT, Injuries and Diseases of.—**INJURIES.**—Some six cases have been reported where the thoracic duct

has been divided by a stab or gun-shot wound, or has been ruptured by external violence. In three of these cases a white chylous fluid—which was whiter and more opaque after meals—escaped at an external wound. In one instance this fluid was effused into the pleural cavity, which had to be repeatedly tapped.

A diagnosis of the injury is impossible without evidence of chylous fluid either escaping from a wound or obtained from the pleural cavity by tapping. In every case death must follow (within a period of time measured by weeks rather than by months) from marasmus consequent upon the discharge.

The treatment is purely symptomatic.

DISEASES.—The duct may be narrowed or occluded as a result of inflammation of its coats, or the blocking of its lumen with cancerous or tubercular material, or by the pressure of an aneurism, tumour, or contracting cicatrices. The whole of the cavity of the duct has been in some cases obliterated. Complete obliteration need not cause death, nor even conspicuous symptoms. The veins appear in such instances to act vicariously, and it is probable that by means of collateral channels much lymph is brought into the right common duct. In a case of Dr. Cayley's the duct was occluded at its point of entry into the vein. It became in consequence enormously dilated, and, rupturing, led to fatal peritonitis. In other cases severe ascites has developed, or some of the lacteals have ruptured. The condition of the duct cannot be diagnosed during life.

The duct has been found enormously dilated as a result, in some cases, of obstruction, and in others as an outcome of unknown causes.

The wall of the duct has been found calcified. Its lumen may be occupied by tubercular or cancerous material derived from some focus of disease in the periphery. So far as the writer can ascertain, no instance of primary growth in the duct has been recorded. FREDERICK TREVES.

THROAT, Injuries of the.—*Wounds* of the throat are very serious: in the first place on account of the important structures which lie in this region; and in the second place because of the arrangement of the cervical fascia, which brings the deeper tracts into close relation with the cavity of the thorax. Many wounds are the result of suicidal attempts, and therefore have an additional element of danger in the depressed condition of the patient.

Those which are produced by accidental violence are most frequently of the punctured form, and they are usually accompanied by some contusion or laceration.

Below the hyoid bone, the cervical fascia divides the tissues into several compartments. In the first there are the superficial structures, together with the platysma myoides, and the vessels and nerves which lie outside the deep cervical fascia. Next, we come to a somewhat limited space, contained between this fascia and the aponeurosis which, after enveloping the depressors of the hyoid bone, terminates by reaching the posterior aspect of the sternum and clavicle. A small quantity of fat and a few lymphatic glands are contained in this space, which is also traversed by the anterior jugular vein. The third space lies between the aponeurosis of the depressors and the prevertebral fascia. The most important structures in it are the larynx and trachea, the pharynx and œsophagus, the thyroid body, the common carotid arteries and the internal jugular veins. The fourth and deepest stratum of all lies underneath the prevertebral fascia, and in close relation with the bodies of the cervical vertebræ.

Many wounds only affect the first or the first two of these compartments, and are usually of a trivial character. The external jugular vein, however, may be wounded, and death has occurred from the entrance of air into its cavity. Diffuse suppuration sometimes follows in the loose tissue beneath the platysma myoides, similar to that which occurs under the aponeurosis of the occipito-frontalis. The edges of the skin-wound are apt to be inverted from the contraction of the platysma fibres. Care should therefore be taken, after thoroughly cleansing the wound, to accurately adapt its edges by fine sutures, either interrupted or continuous, and provision should be made for the drainage of the deeper parts of the wound. The venous hæmorrhage may be arrested by pressure.

The great majority of wounds which affect the deeper parts are transverse in direction, and their most frequent situation is between the thyroid cartilage and the hyoid bone. It will be best to consider the dangers of these wounds and their treatment under the headings of the several structures which may be implicated.

The Blood-vessels.—The large vessels, and more especially the common carotid and internal jugular, frequently escape injury. Their immunity is due, first, to the fact that the incision is usually made so high that the knife is met by the resist-

ance of the cartilages in the middle line and the sterno-mastoids at the sides, before it reaches the deeply seated vessels; secondly, to the tough but yielding character of the vascular walls, which causes them to retreat before the knife; and lastly, to the fact that, as soon as the air-passages are opened, the air rushes out, the chest collapses, and the arms are in some measure disabled from continuing the suicidal attempt. A wound of one of these vessels usually proves fatal in a few minutes from loss of blood, or from the suffocation which follows its entrance into the air-passages. If the wound is high, the lingual and facial arteries, with their branches, may give rise to free hæmorrhage. Lower down, the superior thyroid is especially exposed to injury, and patients have been gradually asphyxiated from the trickling of blood into the trachea after division of the small crico-thyroid branch. Occasionally the inferior thyroid has also been wounded. The patient may for a time recover from the loss of blood immediately following the wound, but succumb afterwards to reactionary or secondary hæmorrhage. There is also more danger of air entering the veins in wounds of this region than in those of any other part of the body.

The Air-passages.—The chief immediate danger is from the entrance of blood, but in some cases the partial detachment of the soft parts or cartilages may cause obstruction to the glottis. Thus, when the wound is above the hyoid bone, the back of the tongue, with the epiglottis, may fall back upon the opening of the larynx. If the thyro-hyoid membrane be divided, portions of the epiglottis or arytenoid cartilages may occlude the rima, and, when the trachea is opened, there may be danger from the bulging in of the adjacent soft parts. The inflammation which follows the wound may cause swelling of the false vocal cords, and so impede respiration; or it may spread along the mucous membrane of the trachea and bronchi, so as to set up broncho-pneumonia. This, which is the most frequent cause of death, when the patients have survived the immediate effect of the injury, is aggravated, and in many cases originated, by foreign materials such as blood, particles of food, and inflammatory products which find their way into the air-passages. There may be temporary or permanent loss of voice from interference with the actions of the vocal cords.

The Food-passages.—If the pharynx or œsophagus be wounded, swallowing will be impeded or prevented; the food will es-

cape through the wound, or be extravasated into the adjacent tissues; or it may enter the air-passages, setting up violent fits of coughing, and leading to dangerous inflammation within the thorax. The food may also enter the air-passages even when the injury is confined to the larynx, on account of the disturbance produced in the muscular movements by which the opening of the glottis is protected during deglutition. When the wound is high up, large quantities of saliva may flow away, causing dryness of the fauces.

The Connective Tissues, Glands, &c.—Air may be forced through the opening into the various compartments of the cervical fascia, and emphysema will be thus produced, which may spread to the face and thorax and even farther. This is especially likely to occur when the external opening is small, or not exactly opposite the wound of the air-passages. The tendency to this complication may also be increased by sewing up the wound in the skin. From the introduction of air, decomposing blood, or food, extensive supuration frequently follows, and this may cause severe pressure upon the air and food passages, or it may run down into the mediastinum, and give rise to inflammation of the pleuræ and lungs. If the wound is high up in the neck, the salivary glands may be injured. Their secretion will flow from the wound, and a salivary cyst or fistula may ensue. If the wound is lower down, it may implicate the thyroid gland, and set up free hæmorrhage from its vascular parenchyma.

The Nerves.—The hypoglossal, the superior and inferior laryngeal nerves are liable to injury, and paralysis may consequently occur in the muscles of the tongue and larynx, or there may be some diminution of the sensitiveness of the laryngeal mucous membrane. Persistent aphonia may follow an injury to the inferior laryngeal nerve. It is possible also that the pneumogastric and phrenic nerves may be pressed upon in emphysema or suppuration of the deeper parts.

Treatment.—The first point is to stop the hæmorrhage, and to provide for the free ingress of air into the lungs. If any large vessel has been wounded, the finger must be introduced at once, and the bleeding point compressed. The patient should be laid upon his back in the horizontal position, and, after rapidly cleaning out the clots from the orifice of the glottis, it may be necessary to resort to artificial respiration until the patient is able to breathe

naturally. The head and neck should now be somewhat extended, so as to open the wound and enable the surgeon to find the source of hæmorrhage. When the internal jugular or one of the carotid vessels is wounded, it is desirable to apply a catgut or silk ligature both above and below the opening. All bleeding points should be secured, and the ends of the ligatures should be cut short, so as to leave nothing dangling from the wound which might be entangled in the dressings, or laid hold of by the patient, if he should persist in his suicidal attempts.

A careful examination should be made, to see whether any of the divided tissues are likely to interfere with respiration. Portions of the epiglottis or the other laryngeal cartilages may be secured in their places with sutures, and in the same way the posterior part of the tongue may be drawn forward. The divided edges of the trachea should also be accurately adapted with sutures. The patient should be placed in a warm moist atmosphere, and the same precautions adopted as after tracheotomy. In some cases it may be desirable to insert a tracheotomy tube through the opening, if it should be below the true vocal cords. In others, upon the supervention of dyspnoea or other symptoms indicating œdema glottidis, it may be necessary to perform laryngotomy or tracheotomy. Expectorants and the carbonate of ammonia will be required, should any evidence of bronchitis or pneumonia be detected.

If the œsophagus should be wounded it will be expedient to bring together the edges with chromicised catgut sutures. When either the air or food passages are implicated, food should be given by an œsophageal tube introduced through the mouth or nose. If this cause much disturbance it may be better to leave the tube in the œsophagus, or nutrient enemata may be given. The tube should not be introduced through the wound. Great care should be taken to ascertain that it has not entered the trachea. This would be indicated by the coughing it sets up, and by the current of air which would escape from the open end of the tube.

One or two sutures may be put in the extremities of the wound to lessen the gaping, and to prevent the inversion of the skin; but it is of great importance to leave the external wound open, so that any blood or food which may get into its deeper cavities may at once escape. With this object in view the approximation of the cutaneous margins should be procured by position

only. The patient's neck should be kept slightly flexed by means of pillows and sand-bags. A long piece of calico bandage should be placed with the centre over the vertex, and the two ends hanging down by the side of the neck and in front of the thorax. A band of calico should now be placed round the head to secure the central portion of the bandage, while the two extremities are firmly attached to the front of a belt of calico placed round the thorax. It may be desirable to substitute strapping for the calico bands, in order to obtain greater security. A light dressing of carbolic gauze should be placed in front of the wound, and secured there by a few loose turns of bandage. This will filter and to some extent purify the air. The patient should be constantly watched by an attendant, to prevent a repetition of the suicidal attempt, and to give warning of the first signs of reactionary hæmorrhage. Later on, the wound is apt to become very foul, and it will be necessary to apply iodoform powder or some other antiseptic to cleanse the parts. Otherwise the fetid discharges may pass into the lungs and set up pneumonia. Abscesses which form should be at once opened, and the ready discharge of their contents should be promoted by drainage-tubes. Quinine may be required to combat the tendency to septicæmia. Fistulous openings into the trachea or œsophagus may persist, and they will have to be closed by operation when the patient has recovered from the more immediate effects of the injury.

Burns and Scalds.—The exposed position of the throat renders it liable to severe injuries of this description. When confined to this region the lesion is not dangerous, but it often gives rise to great deformity, such as the dragging down of the lower lip with the exposure of its mucous surface, and it may even distort the inferior maxilla and invert the lower teeth. Great care will therefore be required, while the granulating surfaces are healing, to resist this tendency, by maintaining the head and neck in the position of complete extension. *See BURNS; CICATRICES, Pathological Conditions of.*

N. DAVIES-COLLEY.

THROMBOSIS, the formation of clot within a blood-vessel, the lumen of which is thereby more or less completely obstructed.

Thrombosis is a necessary factor in the healing of injured blood-vessels, the primary change in cases of so-called adhesive phlebitis, and the most frequent source of emboli. Thrombi are met with both in

veins and arteries, also commonly within the heart, developed on the valves (vegetations), between the muscular trabeculæ or in the auricular appendages. They may be parietal and partially obstruct the circulation, or may completely occlude the vessel in which they are situated. They are usually divided into primary or autochthonous, and secondary thrombi. The former term is applied to the clot deposited at the immediate seat of the disease or injury; the latter to that developed later, stretching to collateral branches, or to that formed around an embolus or foreign body which may have gained entrance to the circulation.

Circumstances under which Thrombosis may occur.—The process depends on the subjection of the blood to such conditions as prevent the maintenance of its fluid state. The coagulation of the blood depends on the union of the two substances fibrinogen and paraglobulin in the presence of the so-called fibrin ferment. Fibrinogen is a constituent of blood-serum; paraglobulin is contained partly in the serum, mainly in the white blood-cells, and these latter are the sole source of the fibrin ferment. This union is promoted by any change from the healthy state in the endothelial lining, or by interruption of the circulatory flow. To the existence of one or both of these morbid conditions thrombosis is to be referred.

Causes of Thrombosis.—1. Increased intravascular resistance, such as may be caused by pressure upon veins by tumours, or by the ligature of a vessel. In the veins in such cases, as a result of the slowing of and resistance to the circulation, the valves stand open and the blood stagnates behind them; hence this is the common starting-place of thrombi.

2. Slowing of the blood-current as a result of abnormal dilatation, seen in phlebotaxis and aneurism.

3. General weakness of the circulation, as seen after fevers or in cardiac disease.

4. Trauma, with varying amount of injury to arterial or venous wall.

5. The entrance of foreign bodies, as in transfixion of a vein by a needle or ligature during an operation on the neighbouring artery; coagulating fluids injected.

6. Disease of the vascular wall—(a) acute, as seen in ulcerative endocarditis or endoarteritis; (b) chronic, as in atheromatous disease.

7. Extension of inflammation from neighbouring tissues, or pressure by inflammatory exudation.

8. The entrance of specific organisms.

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Structure of Thrombi and subsequent Changes observed.—Thrombi may be white, red, or mixed. The large majority are of the white or mixed variety, consisting almost entirely of white cells in a fibrinous meshwork arranged in concentric laminae; the mixed thrombi contain a variable proportion of red discs also. They are developed as long as any circulatory flow exists; the red only when complete stagnation exists, in addition to defective nutrition of the vessel-wall. The changes which take place in thrombi, subsequently to their deposition, are of a twofold character—degenerative or towards organisation.

A. Degenerative Changes.—1. The clot may simply dry up and shrink, eventually undergoing fatty or calcareous degeneration. 2. Simple regressive changes may start from the centre, puriform degeneration taking place. If such a clot be cut across, the central portion is found in a semi-fluid condition, the fluid consisting of a varying quantity of white blood-cells, broken-down red discs, blood-pigment, and granular detritus. The process may be followed by the detachment of irritant emboli. 3. Yellow purulent softening. The change here is a septic one, the broken-down clot being loaded with septic organisms. Emboli from such a source infallibly give rise to metastatic deposits. This change occurs in connection with septic inflammation around the vein.

B. Organisation.—In this case a more or less permanent plug is developed. The first change is the migration of leucocytes into the recent clot, followed by its vascularisation. The origin of the active cell-elements has been much disputed; the larger number are no doubt derived from the white blood-cells furnished by the vasa vasorum, but two other sources are described—(1) the white blood-cells contained in the original clot, and (2) endothelial proliferation. The question as to the first is of little moment, as the number of cells is unimportant, but the latter is said by good observers to be the most abundant. Although denied, it has been in no sense disproved, and when the continuity of the lining membrane of blood-vessels, lymphatics, and connective-tissue interspaces is remembered, it cannot be regarded as improbable. In the presence of the new cell-elements the granular fibrinous meshwork disappears, the red blood-discs break down, and the pigment becomes absorbed. The new cells take on the spindle form, new blood-vessels develop, clefts in the clot lined with spindle-cells forming connections with the vasa vasorum, and

young connective tissue is the result. In favourable cases, vascularisation is apparent at the end of six to seven days; in others it may not be complete for months. Further changes may be simply cicatricial, or canalisation may follow.

The immediate results of thrombosis are not so serious as those of embolism, on account of the gradual nature of the process. Their gravity depends on the size and situation of the vessel affected. General cardiac thrombosis is usually the precursor of death; the parietal vegetations, on the other hand, are chiefly dangerous as the source of emboli. Arterial thrombosis gives rise to primary anæmia and interference with function, which may be followed by congestion due to regressive venous flow from removal of *vis-à-tergo*. Venous thrombosis in the limbs is followed by cedema, which, if permanent, leads to a general condition of lowered vitality and chronic inflammation. If very extensive, gangrene may result. In the organs, temporary interference with function is the usual result, the collateral circulation even in the case of the portal vein being generally sufficient to allow of recovery. The relation of thrombosis to embolism is considered separately; also the local changes in the vessel wall. *See EMBOLISM.*

Symptoms.—The general symptoms will depend simply on altered function, if an organ be affected. The local signs are the palpable presence of a clot, if the vessel be superficial or tangible; otherwise, the presence of anæmia or congestion and cedema.

Treatment.—This consists in the adoption of means calculated to facilitate the circulation in its embarrassed condition, such as rest, the raising of an extremity, the employment of moderate pressure, and, in certain cases, the employment of mild counter-irritants to promote the absorption of clot. The important prophylactic point of avoiding disturbance of recent clot, has been adverted to in the article on EMBOLISM.

G. H. MAKINS.

THUMB, Amputation of the. *See* FINGERS, Amputations of the.

THUMB, Dislocation of the. *See* HAND, Dislocations of Bones of the.

THYROID GLAND, Diseases of the. *Preliminary Remarks.*—Considering the new light which has been recently thrown upon the unsettled question of the physiology of the thyroid body, and the great importance of this question as regards surgical

interference with that organ, it appears desirable to state briefly, before its diseases are discussed, the results of the latest physiological and pathological observations elucidating the consequences arising, to the animal economy, from loss of the function of the thyroid body.

Up to a very recent period it had been, roughly speaking, surmised that the thyroid had no functions at all, though it had been known for centuries that its absence or degeneration was very often connected with cretinism; that both cretinism and goitre were endemic in the same localities; and that goitrous parents often produced cretinous offspring.

In 1874 Sir William Gull described a cretinoid condition supervening in adult women, and characterised by swelling of the body, a particular flush of the cheek, languor of movements and thought, thickness of speech, general placidity of temper interrupted by occasional nerve-storms. Sir William declared himself unable to pronounce definitely about the state of the thyroid in these cases.

Four years later, Dr. Ord, who had the opportunity of making a post-mortem examination in a case of this sort, and who found overgrowth of connective tissue, the interstitial cement of which yielded enormous quantities of mucin in all parts of the body, gave to this condition the name of *myxœdema*. This author first drew attention to the diminution of the thyroid body, associated with an almost complete annihilation of the proper gland-tissue by the mucoid infiltration.

This diminution, sometimes amounting almost to a disappearance of the gland, was noted by many later observers. Still, it was generally supposed to be a result of the pathological process, not a working factor in the production of the other phenomena. Matters remained in this state up to the beginning of 1883. In that year, Professor Kocher of Berne described a curious collection of symptoms, which he had noted as gradually supervening in all his cases of total removal of goitre. Only those of his patients in whom there were either accessory thyroid bodies, or in whom a part of the enlarged gland had been intentionally or inadvertently left behind, remained free from these symptoms. Similar observations had been made by the Messrs. Reverdin of Geneva. On the other hand, it is but fair to state that Professor Billroth of Vienna, who has extirpated more goitres than any living surgeon, states that he has never seen unusual symptoms develop after the

operation. Kocher gave to the state of things developing after the total removal of goitres (goitre is called in German scientific language 'struma'), the name of 'cachexia strumipriva.' The writer of this article, when reading Kocher's paper, came to the conclusion that myxœdema and cachexia strumipriva were practically identical; that the cause of both was loss of the function of the thyroid body, and that the only symptom peculiar to the latter, when total removal of a goitre had been practised in young individuals—viz. arrest of the growth of the body—was undoubtedly to be explained by the fact that (in these cases) the loss of the thyroid made itself felt before the evolution of the body had been completed, whilst myxœdema, on the other hand, was essentially a disease of adult life.

It is, indeed, possible to go one step farther, and to account for endemic cretinism by assuming that it is due to loss of function of the thyroid body, from conditions occurring during intra-uterine life. The writer, in fact, when communicating Professor Kocher's observations to the Clinical Society in 1883, ventured to enunciate the proposition that cretinism, myxœdema, and cachexia strumipriva were merely different phases of one and the same condition, and due to one and the same cause—viz. to arrest of the function of the thyroid gland. This proposition soon found corroboration by the publication of a very remarkable case of total extirpation of the thyroid gland, performed in 1867 on a bright, well-developed boy, then ten years old. Professor Paul Bruns of Tübingen, who saw the patient seventeen years later, reports that he had not merely developed all the usual symptoms of myxœdema, but that the growth of the trunk and of the limbs had become entirely stunted, whilst the head alone had continued to grow; that the patient's mental faculties had undergone not merely arrest but even a retrograde change, and that, in fact, the lad had become a dwarfy cretin.

A further and still more important corroboration of the writer's proposition has quite recently been furnished by Mr. Victor Horsley, who has succeeded in producing myxœdema in the monkey by extirpating the thyroid gland, and who, from his anatomical, chemical, and experimental researches, comes to the following conclusions:—

1. The thyroid body appears to consist of two portions: (a) a glandular, consisting of highly vascular acini, which excrete a

mucoid substance—a mucin-excreting portion (?); and (b) highly vascular lymphoid nodules—hæmatogenous function (?).

2. Excision of the gland is followed by a great increase in the quantity of mucin found in the tissues, an increased activity of the mucin-producing glands, and a change in function of other non-muciparous glands, whereby they become mucin-formers.

3. Profound changes also ensue in the blood. The red blood-corpuscles are decreased with leucocytosis, the coagulability is lessened, and its albumens are altered in character.

4. Nerve-symptoms also appear, changes taking place in the lowest motor centres, causing rigidity, tremors, and paresis. Changes occur in the higher psychological centres, whereby imbecility and cretinism occur, followed by death, which usually occurs in a condition of coma.

Reviewing these facts, Mr. Horsley points out that it is clearly shown that removal or alteration of the function of the thyroid is the cause of the general bodily condition. Whether such changes may be due to the intermediate action of the vasomotor or of a trophic centre, it is impossible to say. When it is remembered that the thyroid body contains a mucinoid material, and that after its removal mucin appears largely in all the tissues, it becomes a question whether the thyroid may not be an excreting gland, the removal of which, as is usual in analogous cases, induces death. In support of this, it is urged that removal of one lobe causes hypertrophy of the other. If, subsequently, the second lobe be removed, myxædematous symptoms arise.

Thus the question stands at the present moment. The limited space allotted to the writer does not permit him to discuss the results and views of other observers (Schiff, Zesas, Wagner, Tauber, Crédé, Hadden, Sanquirico, Canalis, and others).

INFLAMMATION. — *Causes.* — Inflammation of the thyroid gland (thyroiditis) may be of three types: idiopathic, traumatic, metastatic. It may be mentioned here, at once, that inflammation of a previously healthy thyroid gland is altogether rare, and that it occurs much more frequently in cases of enlarged glands (goitres), when all the symptoms hereinafter described are present, as a rule, in still more aggravated form. The idiopathic form is very rare, and its etiology obscure. It is generally attributed to catching cold. Traumatic inflammation may be caused by any violent injury to the gland. Metastatic thyroiditis

may occur in the course of or subsequently to typhoid fever, pyæmia, or puerperal fever; in some rare cases it has followed pneumonia and bronchitis; once it has been observed to alternate with orchitis.

Pathology.—All forms of acute thyroiditis are characterised by the usual changes occurring in inflammations: congestion of the vessels, exudation of serum, emigration of leucocytes. The inflammation may end either in resolution, or in suppuration, or in gangrene. Resolution not rarely occurs in acute idiopathic thyroiditis. Suppuration is the most frequent end of all forms of inflammation of the thyroid gland. Sometimes several abscesses are formed, which generally point outwards, or more rarely perforate into the mediastinum, the air-passages, or the œsophagus. Gangrene is very rare; it may occur when suppuration extends to the connective-tissue capsule of the thyroid gland, and causes phlegmonous inflammation of the fasciæ of the neck.

Symptoms.—Febrile symptoms, sometimes rigors, first occur. There are vague pains about the face, neck, upper part of the trunk, and occasionally the whole body, associated with a feeling of constriction about the throat, dysphagia, sometimes slight dyspnoea. Soon the gland, and shortly afterwards the whole neck, begins to swell; sometimes the whole gland, in other cases only one lobe is thus affected. The inflamed part projects beyond the generally tumefied neck as an isolated tumour of either firm or more brawny consistence. The veins of the neck are turgid, the inflamed region is very tender to the touch, there is continuous or intermittent pain. Owing to the swelling, the following symptoms may occur: compression of the deeper vessels leads to headache, dulness, giddiness, cyanosis of the face, sometimes to epistaxis; compression of the œsophagus to increased dysphagia; pressure upon the trachea and the motor nerves of the larynx to dyspnoea, often very considerable, sometimes fatal, and to dysphonia. Under these circumstances, patients have been observed to bend the head, by preference, backwards.

If the case tends to resolution, all these symptoms may disappear within a few days or weeks. The occurrence of suppuration, on the other hand, is manifested by continued fever, renewal of the rigors, redness, fluctuation where the skin is red, and finally bursting of the abscesses. In rarer cases, suppuration occurs in more centrally situated parts of the gland, when it may be difficult to detect the exact seat of the abscess, and death may be caused by perfora-

tion into the trachea or the mediastinum. In some cases of metastatic thyroiditis, suppuration may occur in the form of an almost painless, cold abscess.

Diagnosis and Prognosis.—Acute inflammations of the thyroid gland can hardly be mistaken for other affections. The prognosis, unless general septicæmia or pyæmia occurs, or unless—as in the metastatic form—the original disease tends to a fatal issue, is not unfavourable, even if gangrene should occur.

Treatment.—The treatment of all forms of acute thyroiditis must be antiphlogistic. In the first stage, constant applications of ice ought to be made over the inflamed organ; leeches may be applied to the supra-clavicular regions, and local or general venesection may become necessary. If, in spite of these measures, suppuration threatens, warm poultices must be substituted for the ice applications, and, as soon as fluctuation occurs, the abscess or abscesses must be opened by incision under antiseptic precautions, or by means of trocar and canula. In cases of deep-seated abscess, the incision must not be too small, and a drainage-tube had better be inserted. Lücke recommends, in those cases in which the trocar is used, after evacuation of the pus to wash out the cavity with carbolic water and to inject some tincture of iodine, after which the wound is to be closed by plaster.

GOÏTRE.—All tumefactions of the thyroid gland not due to inflammatory or malignant diseases, or to the immigration of parasites, are usually comprised under the name of goitre.

Goitre occurs generally in an endemic form, sometimes epidemically (this especially, though not exclusively, in soldiers whose garrison has been changed to a locality in which the disease is endemic), in other cases sporadically. It may be either congenital or acquired. The latter form is most frequently developed at, or immediately after, the period of puberty. The female sex is much more frequently affected than the male, but it is stated that, in India, both sexes suffer in almost equal proportions.

Goitre forms one of the symptoms of the malady known as 'Graves's' or 'Basedow's' disease, or as 'exophthalmic goitre,' which is characterised by prominence of the eyeballs, usually a pulsating swelling of the thyroid gland, palpitations of the heart, and general nervous irritability. In localities where goitre prevails endemically, the domestic animals are not rarely goitrous.

Geographically, endemic goitre may be said to occur mostly in mountainous districts. Thus, according to Lücke's careful compilation, in Europe, the Alps, Pyrenees, Carpathian Mountains, the Black Forest, Thuringia, the Hartz, the Erzgebirge, Riesengebirge; in America, the Cordilleras; in Asia, the Himalayas, are the main localities of endemic goitre. On the other hand, there are mountainous districts in which goitre is little known, such as the mountains of Sweden and Norway, the Scotch Highlands, the Apennines.

In mountainous regions where goitre prevails, deeply cut valleys suffer more than high plateaux. Then, again, whilst large plains are usually free from endemic goitre, the affection prevails in some such plains, as in the Rhine Valley, in Silesia, in Northern Italy, in many districts of France, in the Punjab, and the valley of the Orinoco. It is to be noted that in all the regions just mentioned there are large rivers, often inundating their borders, and marshy low grounds. Low seacoasts are, on the whole, free from goitre; but here also there are exceptions, such as the island of Arran and the Azores.

Causes.—The causes of endemic goitre are at present still enshrouded in mystery. Of all the numerous theories propounded to explain the endemic occurrence of tumefactions of the thyroid gland, none appears to cover the whole question, though each may claim a certain degree of plausibility. Thus the condition of the atmospheric air (especially a humid climate); impurities of the drinking water (snow water, excess of mineral or of metallic contents, organic impurities, want of bromine, iodine, or carbonic acid); geological conditions of the soil (especially those formations which produce water containing an excess of magnesia); a certain 'goitre-miasma,' and individual predisposition (age, sex, heredity, occupation, food, ventilation, and situation of dwellings, &c.), are all accused of producing, alone or conjointly, endemic goitre.

In the etiology of sporadic goitre, heredity plays the most important rôle; next to it, changes in the circulation, arising from the sexual functions of females (menstruation, pregnancy, parturition); finally, all those conditions which favour congestion to the head and stasis in the veins of the neck (carrying of heavy weights on the head, mountain climbing, blowing of trumpets, &c.).

Epidemic goitre may be most fitly designated as a quick development of tumefaction of the thyroid gland in a number

of persons, under conditions favouring the development of the endemic form of the disease.

Exophthalmic goitre is probably due to an affection of the cervical sympathetic nerve, the swelling of the thyroid gland more especially to paralysis of the vaso-motor branches of the sympathetic, giving rise to chronic hyperæmia of the vessels of the gland, and thus favouring the conditions necessary for the production of goitre. This view, however, though probably correct, is not yet definitely proven.

Pathology.—Though, of late, a great many subdivisions of the different forms of goitre have been made, notably by Wölfler, based upon well-marked anatomical differences, it will, for practical purposes, suffice to distinguish between three main forms—viz. simple hypertrophy, cystic and fibroid enlargements of the gland. Between these three forms all possible varieties of transition occur. The enlargement may concern the whole gland or only parts of it. Practically, it is important to note that, in cases in which an accessory gland exists, this may either become goitrous together with the main gland, or even alone. Goitre may form very rapidly, or—and this is more usual—very slowly and insensibly.

In all forms of goitre, the vessels of the gland, especially the veins, are considerably dilated. Goitres in which the vascular changes predominate over the parenchymatous have been called 'vascular,' and, if pulsation exists within them, 'aneurismal' goitres. It is, however, from a practical point of view, as little necessary to describe them as distinctly separate forms, as to look upon the goitre of Graves's disease, in which the vascular changes also often play a predominant rôle, as an individual and distinct form. In reality, exophthalmic goitre may and does occur in any of the three main types just mentioned, though, most frequently, it is the soft parenchymatous form with great vascular dilatation in which it is met with.

Goitre may assume enormous dimensions, or its growth may after a time be arrested; sometimes, even spontaneous resolution is said to take place, especially if the individual leaves a goitrous district, or if he be attacked by an acute febrile disease.

The different forms of goitre, as well pointed out by Lücke, whose classical description is mainly followed in this paragraph, generally represent merely different phases of one and the same pathological process. In the simplest forms (parenchy-

matous or follicular goitre), permanent hyperplasia of the follicles is produced by over-nutrition resulting from repeated or constant congestion of the vessels of the gland. The interstitial connective tissue may become atrophied by pressure, whilst the hyperplastic part may be surrounded by a thick connective-tissue capsule. If, on the other hand, the interstitial tissue shares in the process of nutritive irritation, which it generally does in somewhat later stages of parenchymatous goitre, it begins to grow exuberantly. Then, the second form of goitre, the fibroid, is produced. The fibroid enlargement may be either diffuse or localised. In the former case, the glandular masses appear to be imbedded in very tough bands of fibroid tissue. In the latter case, hard nodules may be found, movable and well isolated from the rest of the gland and from each other. The follicles in these nodules greatly atrophy, and finally only small remnants of them remain, which may undergo cystic degeneration. Sometimes, calcification takes place in very large and very long-standing fibroid goitres.

Parenchymatous goitre frequently degenerates. A rare form of such degeneration is the amyloid, a much more frequent one the colloid, which in turn leads to the development of cystic goitre. The contents of the enlarged follicles being continually changed into colloid material, there is an increase in size, often gained at the expense of the interstitial tissue, which atrophies. The adjacent follicles then coalesce and fill with gelatinous material, and thus, finally, large cysts may be formed. At the same time, the colloid material itself undergoes further changes, hæmorrhage often takes place from the cyst-walls into the cavity, and, finally, a brownish-red fluid containing mucin, albumin, blood, and its constituents, organic detritus, &c., is found to form the contents of the cyst. In rare cases, transparent fluid similar to that of hydrocele has been found. Occasionally, cholesterin, colloid material, phosphate of lime, &c., form the contents of cysts. Parenchymatous goitre may, however, become cystic without passing through the colloid phase. This happens when the follicles undergo fatty degeneration, their contents being replaced by an albuminous fluid. The further progress is the same as that of the colloid variety.

Several cases of hydatid of the thyroid gland have been observed. In some cases, the development of the parasite led to great enlargement of the gland, and even pro-

duced serious dyspnœa. Two cases are known in which the cysts perforated the trachea, and immediate death ensued.

Most cystic goitres are multilocular; a unilocular cyst being formed only by atrophy of the septa between the cysts. Often, however, even in such cases, a kind of fibroid stroma traversing the cyst remains. The capsule of the cyst is generally thick and smooth. Not rarely, more or less, extensive calcification or ossification takes place within large, and even within small, cysts. Large goitres, in consequence of their gravity, generally become pedunculated, the pedicle consisting of connective tissue, vessels, and nerves.

Finally, it must be stated that goitrous thyroid glands show a decidedly greater tendency to become inflamed and to undergo malignant degeneration, than previously healthy glands.

Symptoms.—Apart from the external disfigurement of the neck, the main symptoms of goitre are due to pressure exercised by the tumour upon neighbouring parts, especially upon vessels, nerves, muscles, air and food passages. All these symptoms are the more marked the less pedunculated the goitre is; thus, enormous tumours hanging down in front of the chest often cause much less serious symptoms than much smaller tumours, which from their situation interfere with the function of important parts in their vicinity.

Amongst the first and most frequent symptoms, caused by small or non-pedunculated goitres, is stasis in the veins of the tumour themselves, and in those of the neck and head. The former often appear as a large plexus on the surface and in the parenchyma of the gland, the superficial veins of the neck being at the same time much enlarged. With every effort these veins are further dilated. The veins of the head also sometimes suffer similarly, the face of the patient appearing turgid and red with every effort. The return of blood from the veins of the brain being sometimes impeded, the patient is apt to suffer from headache, giddiness, drowsiness, &c. On the other hand, tumefaction of the thyroid gland may lead not only to very considerable dislocation forward or backward of the carotids, but also to compression of these vessels, to diminution of the blood-supply to the brain, and to more or less marked phenomena of cerebral disturbance, such as convulsions, tetany, epileptoid attacks, the so-called 'goitre-asthma,' and perhaps also to—sometimes fatal—spasm of the glottis from cerebral anæmia.

It is probably to such disturbances of the circulation in the brain, and not to pressure upon the pneumogastric nerves, that the transitory and varying paralysis of the adductors of the vocal cords, accompanied by aphonia, sometimes observed in young females affected with soft goitres, and mostly occurring at times of general disturbances of the circulation (menstruation, pregnancy) must be ascribed.

Direct pressure upon the nerves of the neck is often met with in the harder forms of goitre. The motor laryngeal branches of the vagi suffer almost exclusively. More sudden pressure may cause phenomena of irritation—i.e. spasm of the glottis (which, however, as shown above, may have an entirely different origin); more gradual pressure produces in the first place paralysis of the abductor fibres of the recurrent laryngeal (of both, if there be simultaneous pressure upon both recurrences, or pressure upon *one* pneumogastric nerve). Later on—i.e. when *all* the fibres of the nerve are disabled—complete paralysis of the corresponding vocal cord results. See LARYNX, Neuroses of the.

Of muscles, the sterno-mastoid is most liable to be thinned and flattened out by pressure.

The most frequent and most important symptom caused by hard, non-pedunculated goitres is dyspnœa, due to pressure upon the air-passages, notably upon the trachea. The larynx is not rarely considerably displaced, but hardly ever actually compressed. The trachea, on the other hand, is not only displaced, but the pressure causes at the same time softening of its cartilaginous rings and actual changes of its calibre. Thus, the wall of the windpipe may be either bulged inwards on one or both sides, or from the front; or a circular goitre may constrict it on all sides, or it may be pressed against the vertebral column, or be quite bent over a hard goitrous nodule, &c. The dyspnœa is in proportion to the degree of narrowing. In slighter cases, tracheal stridor only occurs after efforts, in more severe cases it is constant. The dyspnœa is sometimes of the most serious kind, especially in cases of small sub-sternal goitres pressing the trachea against the vertebral column ('goitre plongeant' of the French). Even if not immediately fatal, the deficient aëration of the lungs, coupled with ever-present increased respiratory efforts, generally causes, after a time, important organic changes of the thoracic organs, emphysema, pulmonary catarrh, dilatation of the right side of the

heart, &c. In cases of *tracheal* narrowing, the larynx does not rise and fall in respiration, however great the dyspnoea may be.

From a surgical point of view, attention is once more to be directed to the fact that the same goitre may dislocate and compress the trachea, and simultaneously paralyse both abductors of the vocal cords. In such a case, a *double* stenosis of the air-passages results; an upper by diminution of the glottic aperture, a lower by compression of the trachea. It is rare that the gullet is compressed by goitre. A small so-called 'aberrant' goitre may be situated between the trachea and oesophagus and compress both canals, or the enlarged lateral lobes of the gland may not allow the gullet to shift its position. Dysphagia then occurs.

Sudden increase of a cyst means, usually, hæmorrhage from the lining walls into its interior; rapid increase of volume of a goitre which had for a long time remained stationary, together with pain and swelling of the lymphatic glands of the neck, points to malignant degeneration.

Diagnosis.—The diagnosis of goitre is for the most part easy. There are, however, cases in which it is very difficult, if not impossible, to distinguish goitre from other tumours of the neck; and, again, it may be very difficult to differentiate between the individual forms of goitre.

A general diagnosis will be arrived at by considering the history of the case, the characters of the tumour, and the associated signs: enlargement of vessels, paralysis of one or both vocal cords, bulging inwards of the trachea. In arriving at a differential diagnosis of goitre from other tumours of the neck, it is a very important factor that goitre rises during the act of swallowing, whilst other tumours do not, unless fixed by newly-formed connective tissue to the air-passages. Small substernal goitres are sometimes apparent to sight and touch during the act of swallowing only.

Simple congestive swellings of the thyroid gland are generally transitory, and are due to menstruation, pregnancy, &c.; the neck appears somewhat full, and it is often difficult to make the gland out by palpation.

Parenchymatous goitre is more resistant and more sharply limited. Generally, only parts of the gland are hypertrophied. These are smooth, somewhat elastic, only moderately enlarged. Fibroid goitre is characterised by a number of single, movable, hard nodules, which project from the generally hypertrophied gland. If there be calcareous deposits in the nodules, their

hardness is still more pronounced. Fibroid goitres often assume enormous dimensions.

Cystic goitre is usually globular or ovoid, sharply limited, and, when filled with thin fluid, shows distinct fluctuation. If, however, the wall be very thick or the contents more atheromatous, it may be very difficult to be sure whether there is fluctuation. Under such circumstances, an exploratory puncture must be made with a very fine trocar. Great care, however, should be exercised when this proceeding is determined upon, for dangerous hæmorrhage may be produced if the trocar unfortunately should injure a large vessel. The puncture should always be made under antiseptic precautions.

The goitre of Graves's disease is characterised by vascularity, often by pulsation, and by the accompanying exophthalmos, rapid pulse and palpitations; often by blood-murmurs of the heart, in the carotids, and in the vessels of the thyroid gland.

Mixed forms (multilocular cysts, fibroid nodules, general parenchymatous enlargement,) are to be diagnosed by their unequal consistence, and, if necessary, by exploratory puncture.

The differential diagnosis of goitre from other tumours of the neck, is rendered in some, fortunately rare, cases exceedingly difficult, by the fact that occasionally so-called 'accessory' or 'aberrant' portions of thyroid tissue at a considerable distance from the natural situation of the thyroid gland, undergo goitrous changes. Even greater difficulties may present themselves when such aberrant masses of thyroid tissue are situated near the hyoid bone, behind the sterno-mastoid muscle, in front of the substernal portion of the trachea, between the trachea and oesophagus, &c. It will, therefore, be advisable to remember, in every case of tumour of the neck, the possibility of its being an 'aberrant' goitre. The tumours most likely to be confounded with goitre are congenital cysts (sometimes with sebaceous contents), blood-cysts, hydatid cysts in the gland itself or in other tissues of the neck, cold abscesses originating from broken-down lymphatic glands, fatty growths, adenomata, lymphomata and sarcomata of the lymphatic glands, and malignant tumours of the thyroid gland. The nature of cystic tumours, in the situation of the thyroid gland, will generally have to be made out by exploratory puncture. From malignant tumours of this neighbourhood, whether they start from the thyroid gland itself or from other structures, goitre is distinguished by its usually slow growth,

painlessness and absence of tenderness on pressure, non-infiltrating character, and absence of general cachexia. It has been repeatedly mentioned that goitre may undergo malignant change. This occurs sometimes, without any apparent cause, in cases in which a goitre has been in existence for twenty years or more. All the symptoms just mentioned will then arise.

Treatment.—If an individual living in a goitrous district becomes affected with goitre, he ought to leave the neighbourhood as quickly as possible. Recent goitres often disappear without further medication, if a change of residence into a non-goitrous locality, especially to the seaside, can be effected. It has also been advised that the patients, and, in fact, all living in goitrous districts, especially all those who have recently moved into them, should drink only *boiled* water.

The treatment varies considerably according to the nature of the goitre.

Apart from change of residence, sojourn at the seaside, &c., iodine preparations are most serviceable in cases of soft, parenchymatous goitre. They may be administered in the form of an iodide of potassium mixture (5–10 grains twice or three times daily) combined with the external use of an iodine ointment. The writer has often seen good results from the use, once or twice daily, of a combination of one part of the ung. iodi (B.P.) to 2–4 parts of the ung. potassii iodidi (B.P.). Broadly speaking, the effect of this treatment is the better and quicker, the younger the individual and the more recent the goitre. In recent cases, even comparatively large goitres often very rapidly and entirely disappear; in goitres of longer standing, some diminution generally takes place, but not complete cure. The biniodide of mercury ointment, the applications of which in India are reported to be so marvellously successful, appears to have yielded less satisfactory results in the hands of European practitioners. Possibly the absence of the tropical sun, to the rays of which, in India, the neck of the patient is exposed during and after the application, may in some measure explain the difference. Dr. Morell Mackenzie recommends counter-irritation to the neck by means of applications of the liquor epispasticus (B.P.) in cases of soft goitre. The iodine treatment above described will, however, be found to suffice in most cases.

Recently, Dr. Moritz Schmidt has advised, in cases of soft and of fibrous goitre, the permanent application of cold to the patient's neck by means of Leiter's hollow

lead-tubes, which are fastened round the patient's neck, and through which a current of cold water constantly circulates. In simple cases, these tubes are to be worn twice daily, each time for three hours; in cases in which dyspnoea is present, day and night. Dr. Woakes has lately recommended the internal use of hydrofluoric acid as an adjunct in the treatment of bronchocele. He administers ten minims (or more) of a half per cent. solution of the redistilled fluoric acid in an ounce of water, twice daily. The results appear to be somewhat uncertain. Several observers have added their testimony to its satisfactory effects; but in the hands of others—and the writer must class himself amongst them—the remedy has not yielded appreciable results, in spite of long-continued and repeated trials.

Should no good effect follow medicinal treatment in long-standing cases of soft goitre, parenchymatous injections of iodine may be resorted to with a good prospect of effecting a cure; and this form of treatment will also be found useful in cases of fibrous goitres, provided that the latter are not too old, too hard, and partly calcified.

The rules adopted by the writer are as follows:—(1) Select suitable cases only—i.e. cases in which the gland-substance is so thick that one may be fairly certain that the injection can be made into the parenchyma proper, and in which, on the other hand, the interstitial fibroid change has not progressed too far. (2) Inject every third day into the gland-substance proper a quantity, from 20 to 30 drops, of an alcoholic iodine solution (1 part of iodine in 12 parts of absolute alcohol), with a well-made and well-cleaned hypodermic screw-syringe. (3) Vary as much as possible the place of injection, and never inject into the same neighbourhood on two consecutive occasions. (4) Avoid wounding superficial veins and injecting air. A piece of tape may be tied round the neck below the tumour, so as to compress the superficial veins. (5) Neither insert the point of the needle *too timidly*, when the injection-fluid will very likely pass into the cellular tissue, suppuration resulting; nor *too violently*, when it may completely perforate the gland, and the injected fluid may be thrown into other important tissues. It is a good plan to let the patient swallow when the needle has been inserted, before the injection is proceeded with, the body of the syringe being held quite loosely in the operator's hand; if the point of the needle is in the gland-substance, the *foremost*

part of the syringe will rise with the rising gland; if it be in front of the gland, no movement will ensue; if it have perforated the gland, the *hindmost* part of the syringe will chiefly rise. (6) Never inject in such a direction that the point of the needle points directly towards the trachea or towards the great vessels and nerves of the neck. (7) Inject very slowly, and watch especially the effect of the injection of the first few drops. Select the place of injection carefully beforehand by palpation, and steady the tumour with the left hand whilst making the injection. Previous freezing of the surface with anæsthetic ether round the point selected for injection may be resorted to, but is not necessary.

Attention to the foregoing important precautions is very necessary to avoid unpleasant results. It must, however, be confessed that, even if they are punctiliously attended to, this form of treatment is not altogether devoid of risk, the principal dangers being—(1) injection of iodine or air into a vessel, causing embolism and sudden death; (2) lesion of the pneumogastric or of the recurrent laryngeal nerve, followed in some instances by spasm, in others by lasting paralysis of the vocal cord or cords; (3) suppuration and putrefaction of the goitre. All these dangers are fortunately very rare, but, without any doubt, their occasional occurrence has been positively ascertained by clinical observation and by post-mortem examination, whilst, at the same time, they are—at least to some extent—uncontrollable. The writer, therefore, is of opinion that it is the duty of every surgeon not to represent the operation as a perfectly safe one, but to inform the patient or his friends, before beginning the treatment, of its risks.

Frequently, the patient complains, at or immediately after the injection, of radiating pains in the teeth, the occiput, the chest, &c. These symptoms are of no serious import, and usually pass away after a few moments. Shortly afterwards, slight tenderness and swelling over the point of the injection generally result, which are easily relieved by cold-water dressings. No definite statements can be made as to the number of the injections necessary to complete a cure, or the time required for treatment, both depending on the duration of the goitre, its size, and character.

Instead of iodine solutions, other injection-fluids have been recommended at various times, notably pure alcohol, ergotine d'Yvon, liquor arsenicalis, and hyperosmic

acid, but none of these have come into general use.

The treatment of parenchymatous, and especially of fibroid, goitre by means of setons, which was at one time very much in vogue, has been almost entirely superseded by the iodine injections.

For the treatment of cysts three methods are employed: puncture with subsequent injection of an irritant fluid, incision, and excision. Simple aspiration has been given up almost entirely, as experience shows that the cyst, when simply emptied, almost always fills again very rapidly. Besides, simple aspiration is not quite safe.

In the writer's experience, the injection of perchloride of iron into the cyst yields more satisfactory results than injections of iodine, though it cannot lay claim to absolute safety. The best method of injection is that described by Dr. Morell Mackenzie in the following words:—‘In carrying out this mode of treatment, I use a watery solution of perchloride of iron (25 per cent.), and I have for many years employed a syringe of somewhat peculiar construction. It consists of an ordinary glass barrel and piston, with a tapering metallic tube fixed at a slightly obtuse angle to its distal extremity. A circular ring, screwed on to the shank of the piston, regulates the distance to which the latter can descend. The object of this cylinder is to prevent the accidental passage of air into a cyst, and thus into a vein. . . .

‘The cyst is first punctured and emptied with a trocar at its most dependent part, a drachm or two (according to the size of the cyst) of the solution of perchloride of iron is then injected, the canula with its plug, and the iron solution being left in the cyst. After seventy-two hours the plug is removed, and the contents of the cyst withdrawn.

‘If the fluid be then found to contain much blood, or if it be thin and serous in appearance, a second injection must be made. In other words, whilst hæmorrhage must be carefully prevented, a slight inflammation of the lining membrane of the cyst is essential. One injection is generally sufficient, but, if the first injection-fluid be too quickly removed, the process may have to be repeated three or four times at intervals of two or three days.

‘When reaction has taken place, and the discharge is free from blood, the canula, with its plug, must still be kept in the cyst. Poultices of linseed meal should be kept constantly applied for three or four weeks,

sometimes longer. When suppuration is well set up, the plug may be removed, the canula, however, being allowed to remain until the secretions become limited in amount and thin in consistence.

'When the cyst is very large, it is best to try to reduce the quantity of the fluid before injecting. This can often be done by drawing off a small amount, say two or three drachms, at intervals of a day or two on several occasions. No attempt must, however, be made to empty the sac entirely, for if this is done, hæmorrhage takes place from the lining membrane of the cyst into its cavity, which soon becomes full again.

'The duration of the treatment is from three weeks to four months, according to the size of the cyst, the usual time being six to eight weeks.'

Incision of the sac, followed by suture of the free edges of the lining membrane to the edges of the skin-wound, has been recommended and executed with satisfactory results in a considerable number of cases; but there are several drawbacks to this treatment, amongst which may be enumerated the possibility of primary and secondary hæmorrhage, putrefaction within and around the sac, formation of fistulous communications with neighbouring parts, &c. The operation and the after-treatment should be carried out under strict antiseptic precautions, and all bleeding vessels be tied immediately, which is not always easy, especially if secondary hæmorrhage in the bottom of the sac occurs. In some cases, plugging of the sac with styptic tampons may be unavoidable.

In cases in which it is found that a large cyst, enclosed in a very thick fibrous wall, is only loosely connected with the surrounding parts, extirpation might be advantageously undertaken. This operation will best be performed, under antiseptic precautions, by shelling the sac out of its surroundings as much as possible by means of the finger or of blunt instruments, by ligaturing every vessel torn during this proceeding, and by dressing the resulting wound antiseptically.

Whilst, by means of one or the other of the above methods, it will be possible, in the larger number of cases, to prevent the occurrence of those grave symptoms which have been described in the paragraph on symptomatology, yet there are some goitres which unfortunately do not appear to be amenable to any form of treatment; whilst others come under observation

when these symptoms have already been fully developed, and when no relief can be expected from the adoption of any of the methods above recommended.

The grave symptoms referred to are mainly those of narrowing of the air-passages, which in turn, as has been shown, may be produced—(a) by direct compression of the trachea, (b) by spasm of the glottis, (c) by paralysis of the glottis-openers, (d) by the simultaneous existence of the conditions mentioned under (a) and (c). Now it is clear that, if we could be certain of opening the air-passages below the seat of the obstruction, this would be the simplest way of averting impending suffocation; but, in the first place, it is often impossible to say how far down the trachea is obstructed, and, secondly, the technical difficulties of tracheotomy in cases of large goitres are often enormous, sometimes insuperable. Unless the goitre extends too high up, the operation consists in opening the fascia propria, pulling down the isthmus of the gland by means of blunt instruments, opening the air-passages above the gland, and inserting one of Koenig's long flexible silver canulas, which are intended to force their way through the compressed part of the trachea, or, should no such canula be at hand, using a common elastic catheter for that purpose. In other cases, the surgeon may be compelled to ligature the isthmus on both sides, to split the ligatured part in the middle line, and then to open the trachea in the usual way. If, however, the goitre be large, it will often be found that, in spite of the ligature *en masse*, severe hæmorrhage occurs when the isthmus is split, and the bleeding vessels will then have to be tied *seriatim*.

Much precious time is often thus lost, in cases in which the operation is performed in the greatest hurry to save the patient from impending suffocation. If the operation be performed at all, it is very important to keep the head very steady during the whole of the operation to prevent collapse and tilting of the trachea, and to keep it so afterwards by sandbags.

In order to reach the cause of the evil, and to ensure a radical cure in serious cases, removal of the goitre may be necessary. The operation, which in former years was very fatal, is now, owing to advances in antiseptic surgery and improved methods, far less so than formerly; to the actual dangers of the operation must be added the possible occurrence of subsequent symptoms of myxœdema, due to the loss of the thyroid gland. It appears, however, that

myxœdema is not likely to occur if a small portion of the gland is left behind. The writer is, therefore, of opinion that extirpation of a goitre may be undertaken when the condition of the patient appears to render this strictly necessary, provided that it is possible to leave behind a portion of the tissue of the gland.

With regard to the operation itself, there is at present considerable difference of opinion, but probably Kocher's method is the best. It is thus described by Sir W. MacCormac:—

'The manner in which the enlarged thyroid gland may be excised varies. It is essential to provide for an aseptic condition of the wound, and so avoid septic infiltration of the cellular tissue of the neck, which is very sudden in appearance, often without any very marked external change, while the result is almost always fatal. It is not less important to control hæmorrhage, as far as possible, and to avoid injury to the recurrent nerve. The superficial incision may be of two kinds, an angular and a Y-shaped. Where the enlargement is chiefly confined to one side, a median incision should first be made from the upper margin of the tumour to the notch of the sternum. In this way, only the transverse communicating branches of the veins will be divided, and from the upper extremity of this incision ample room can be obtained by making an oblique incision upwards and outwards, which should extend from the level of the cricoid cartilage to the anterior border of the sterno-mastoid muscle, or further, if necessary, in the direction of the mastoid process. The skin and platysma having been divided, the superficial veins will be cut through at right angles, and may at once be tied with double ligatures. Where the thyroid enlargement is bilateral, a similar oblique incision may be made on the opposite side. After the platysma and superficial fascia have been divided, the sterno-hyoid, sterno-thyroid, and omo-hyoid muscles appear spread over the tumour. As a rule, especially if the tumour be large, these must be divided, and, in some cases, part of the sterno-mastoid muscle as well; but this entails no serious after-consequences. The tumour will now be fully exposed, with enormously dilated veins covering, probably, its entire surface. These veins must be tied, one by one, with a double ligature before division.

'The greatest care must be taken at this stage, for the veins are not only huge in size, but their walls are very thin and

easily torn or cut through by the ligature. The tumour may now be carefully separated by the finger, or handle of the scalpel, until the position of the superior thyroid artery at the superior lateral extremity of the thyroid body shall be reached. Here the superior thyroid artery will be found entering the tip of the thyroid tumour, and, either separately or together with its vein, must be carefully double-ligatured and divided between. The artery is generally much enlarged, and its walls are very thin.

'Search is now made for the inferior thyroid artery, which must be most carefully isolated previously to ligature. This may be applied as far as possible from its entrance into the tumour. . . . In this way the recurrent nerve will be well protected from injury. The inferior thyroid artery, after leaving the thyroid axis, passes transversely behind the outer border of the thyroid, and for some distance on its posterior surface before it penetrates the gland, after dividing into several branches. Close to the trachea, the trunk of the artery passes behind the recurrent nerve, which it partly encircles. The branches of the artery may be divided, after ligature, close to the surface of the gland, and bleeding will not occur owing to the preliminary ligature of the main trunk. . . . The tumour may now be turned towards the median line and lifted from the trachea. The further isolation should be conducted as carefully as possible until the isthmus is reached, which should be most carefully divided, each bleeding point being secured as it appears. When the enlargement is bilateral, the same operative procedure must be conducted on the opposite side. It is very important, if possible, to avoid performing tracheotomy, as it enormously increases the subsequent risks. . . . When tracheotomy is necessary, as it fortunately seldom is, the wound becomes speedily septic. It is better under these circumstances to treat it as an open wound with frequent irrigation, in the hope of preventing the fatal mediastinal infiltration which so often occurs.'

Finally, an operation must be mentioned, which, though only in its infancy, promises to be of excellent service in those cases in which operative interference is indicated on account of attacks of severe dyspnoea. This is *resection of the isthmus*, with or without the innermost part of the lateral lobes of the enlarged gland, an operation first advocated by Sir Duncan Gibb, and repeatedly performed with suc-

cess during the last few years by Mr. Sydney Jones. The operation is very simple:—The isthmus is carefully isolated. After having been exposed by a median incision, double ligatures are passed round its lateral parts, and the ligatured part is cut out, every bleeding point being secured as it appears. From the deep gutter thus created in front of the trachea, free drainage is secured during the process of healing. The results obtained by Mr. Jones with regard to relief from dyspnoea, dysphagia, laryngeal cough, &c., were very satisfactory. Perhaps the most remarkable result of this operation, however, is the fact that the lateral lobes left behind appear to shrink after the removal of the isthmus.

FELIX SEMON.

THYROID GLAND, Injuries and Wounds of the.—Injuries and wounds of the thyroid gland are comparatively rare. When they do occur, other and more important organs (larynx, trachea, carotid artery, jugular vein, vagus, œsophagus) are, usually, simultaneously implicated. The isthmus is exposed to injury during operations performed in order to open the air-passages, and in homicidal attempts. The hæmorrhage which results is sometimes considerable. If the gland be injured by gunshot wounds, there is generally at first parenchymatous bleeding, not rarely violent secondary hæmorrhage. If larger vessels are injured, they should be ligatured if possible; if this, however, is impossible (especially in cases of secondary hæmorrhage), it may be necessary to tie the carotid or the subclavian. In parenchymatous hæmorrhage, digital compression ought to be tried; styptics must, if possible, be avoided, as extensive suppuration may be the result. There is no objection to sutures in incised wounds of the thyroid gland; under antiseptic precautions they often will heal by first intention. In addition to wounds, the thyroid gland is exposed to contusions, which may be followed by subcutaneous rupture of vessels. In all forms of injury, extensive infiltration, partly sanguinolent, partly œdematous, of parts of the gland or of the whole gland, and even of the neighbouring tissues, may ensue. This in turn may lead to active inflammation, manifested by any or all of the symptoms mentioned under that heading. See **THYROID GLAND, Diseases of the.** In the first stage of all injuries of the gland, energetic antiphlogistic treatment (ice, or Leiter's tubes to the neck, &c.) ought to be adopted; should active inflammation occur,

this must be treated in the same manner as a common inflammation of the gland.

If, instead of a normal, an enlarged thyroid gland is injured, the chain of events is practically the same, only the symptoms, especially in the cystic forms, may be much more severe. Thus, in consequence of contusion, considerable hæmorrhage may take place into a cyst, leading to rapid and enormous enlargement of the latter, with compression of vessels and nerves, of the trachea, of the œsophagus, &c. Should the symptoms (dyspnoea, dysphagia) in cases of this kind be very severe, it may be necessary to puncture or even to incise and plug the cavity. In cases in which the symptoms are not so severe, the treatment recommended for wounds and contusions of the normal thyroid gland may be adopted. If possible, the bleeding vessels should be tied one by one. If a cyst has been opened by an injury, it will be best to treat it as if the cyst had been intentionally incised. In conclusion, it may once more be stated that all wounds of the thyroid gland in which the air passages have not been opened ought to be treated antiseptically, and that the artificial opening of the air-passages ought to be, if possible, avoided, as the wound becomes speedily septic under these circumstances.

FELIX SEMON.

THYROID GLAND, Malignant Disease of the.—The malignant new-formations developing in the thyroid gland may be sarcomatous or cancerous. The causes of their origin are unknown, but it is certain that enlarged thyroid glands are much more liable to malignant degeneration than previously healthy glands. It is not very rare for a goitre which has been in existence for twenty years or more, and the progress of which has been entirely arrested for a considerable number of years, suddenly, without any external injury or other evident cause, to undergo malignant change.

Sarcoma of the thyroid gland is comparatively rare. It may be very vascular, and may be either of the spindle, or of the round-celled variety. It develops very rapidly, early infiltrates the skin and the tissues of the neck, though it usually leaves the glands of the neck free, and encircles especially the great vessels. The air- and food-passages, however, are not frequently pressed upon to any serious degree. The reason of this is probably to be found in its very soft consistence, which may actually give rise to mistakes with regard to apparent fluctuation. The growth is very liable to sloughing and ulceration, with violent hæmor-

rhages and putrefaction. High fever and death from the local changes ensue, usually in the course of the first year after the growth has been noticed; in other cases metastatic tumours appear in the lungs and in the liver, and cause death.

Primary cancer of the thyroid gland is by no means so rare as had been supposed up to recent times; especially in goitrous districts it comes comparatively often under observation. *Metastatic cancer* of the gland, on the other hand, does not appear to be frequent. The different forms of cancer which are met with in the thyroid gland are simple glandular carcinoma, epithelioma, and scirrhus. The glandular character, unless masked—as in the scirrhus forms—by proliferation of connective tissue, is very marked. The epithelial type may vary; some forms show more the character of cylinder-epithelial, others of pavement-epithelial, carcinoma.

Sometimes *secondary* tumours are observed, especially in the bones, which marvellously imitate the characters of the primary tumour, and which may attain a very considerable size. In other cases, metastasis occurs in the lungs and other internal organs. The progress of carcinoma of the thyroid gland is, usually, rather slow. There is generally, at first, gradual increase in size of the thyroid body, with occasional lancinating pains and enlargement of the anterior cervical lymphatic glands. After some time, the different organs of the neck are either compressed or infiltrated; the trachea may be displaced and narrowed, the œsophagus greatly compressed, the arteries and veins either compressed or entirely obliterated. The pneumogastric, recurrent laryngeal, cervical sympathetic nerves, and the brachial plexus may be involved.

The *symptoms* vary according to the organs interfered with: if the trachea be compressed, dyspnoea will ensue; if the œsophagus be narrowed, dysphagia will arise. Should the great veins be compressed or obliterated, cedematous swelling of the whole part will be produced; should the carotids be compressed, symptoms of cerebral anæmia may occur.

The nervous symptoms are equally variable. Compression of the sensory nerves of the part leads to very violent pains in the neck, which may also radiate into the occiput, the teeth, the area of the brachial plexus, &c. Compression and gradual destruction of the vagus may cause cardiac palpitation, and paralysis of the vocal cord or cords. See LARYNX, Neuroses of the.

Compression of a recurrent laryngeal nerve leads to paralysis of the corresponding vocal cord, the abductor fibres suffering first. Compression of the cervical sympathetic is the probable cause of the ptosis, sometimes seen on the side corresponding to the side on which the tumour is chiefly developed. Compression of the motor roots of the brachial plexus leads to more or less complete paralysis of the corresponding upper extremity.

Sometimes, there is a period of arrest even after the cervical glands have become infiltrated. This occurs, especially, when calcification takes place simultaneously in the thyroid body and in the affected glands. More frequently, however, the tumefaction steadily increases. Occasionally, adhesions are formed with the skin, which is gradually destroyed, and the tumour fungates. As a rule, however, general cachexia, dyspnoea, impossibility of swallowing, hæmorrhage, perforation of the malignant growth into the trachea or veins, secondary metastases, &c., bring about the fatal end before the tumour breaks down.

The *diagnosis* of carcinoma of the thyroid in its initial stages is not easy. It is always a suspicious circumstance when, in a person above the age of thirty-five, a goitre which has remained stationary for several years begins to grow afresh and becomes painful. The further progress, the usually very great hardness of the tumour, the early dysphagia, the infiltration of the neighbouring lymphatic glands in cases of carcinoma, the almost fluctuating softness in sarcoma, finally confirm the diagnosis.

The only *treatment* which offers any prospect of relief is total extirpation of the diseased organ, and cases in which, at a comparatively early period, the existence of malignant disease has been diagnosed with certainty are, indeed, the only ones in which total extirpation would appear to be justifiable. In not a few cases, however, even of apparently *early* malignant degeneration, the surgeon who undertakes the operation will find the usual difficulties of extirpation increased tenfold, owing to the infiltrating character of the malignant growth. In not a few cases he may be compelled to leave the operation unfinished, owing to involvement of the large vessels or nerves in the tumour; or, on the other hand, to extirpate other parts (larynx, part of the œsophagus, or pharynx), together with the diseased thyroid body.

The *prognosis* is, under any circumstances, most serious. Still, there are several

cases on record in which the patients survived the operation for several months, and as lingering and terrible death is certain unless the diseased gland is removed, the operation, serious as it is, is fully justified.

FELIX SEMON.

THYROTOMY.—This term is used for the operation of laying open the thyroid cartilage in order to gain access to the larynx, less for purposes of facilitating respiration, than with a view to remove any mechanical conditions which may be interfering with laryngeal function or be otherwise dangerous to life. For the former purpose, the proper operation is either **LARYNGOTOMY** or **TRACHEOTOMY**.

The *indications* for thyrotomy are not numerous; among these, as the most common may be mentioned—certain cases of foreign bodies tightly wedged in the neighbourhood of the vocal cords, or in the laryngeal ventricles; strictures following ulcerative disease, burns, or other injuries; morbid sessile growths on (and chiefly below) the vocal cords, especially in the case of young and delicate children. Thyrotomy pure and simple is very unlikely to be performed on the living subject, for the cases, in which such an operation is called for, almost of necessity involve the subsequent use of a tracheotomy tube. Hence the question always arises, Shall the entire larynx, including two or three rings of the trachea, be laid open, or shall tracheotomy be performed independently, and, if so, shall this operation be done at the same time as, or a few days previously to, the thyrotomy? Unless there is something specially indicating the latter mode of procedure, the writer would recommend one operation. The chief object of a thyrotomy is to secure a free and full view of, as well as access to, the larynx. This will be best accomplished by opening the entire larynx and upper part of the trachea simultaneously; among other advantages, the *alæ* of the thyroid cartilage can be more widely separated than when a shorter incision is made.

THE OPERATION.—The patient being *anæsthetised*, a vertical incision, commencing a little above the *pomum Adami*, is made through the skin and fascia in the median line of the neck. This must be prolonged downwards to the isthmus of the thyroid gland; the muscles in front of the trachea and cricoid cartilage must be separated and drawn aside; any vessels which are met with must be treated in the same way; the trachea and cri-

coid cartilage are then incised (*see* **TRACHEOTOMY**) in the usual way, and a dilator inserted. This proceeding relieves all dyspnoea and any local blood-stasis which may have resulted. In some cases of papilloma, the growth will be visible through the wound at this stage. It may be well now to insert a tracheotomy tube, or a tampon; a piece of india-rubber tubing, of suitable calibre and length, lightly wedged in the trachea with a small bit of sponge to prevent blood trickling down, will be found both handy and efficient. The incision is next prolonged upwards through the crico-thyroid membrane, and thence into the thyroid cartilage, great care being taken to make it *exactly in the median line*. Suitable retractors being now inserted, the surgeon will see whether it is necessary to prolong the incision, and how far. An attempt should be made to preserve the integrity of the cords; if their anterior commissure must be cut, it is desirable to not quite sever the two thyroid *alæ*. In children and young subjects, in whom the cartilage is still elastic, retraction will accomplish much; but in old people, and in cases where it is necessary to get at the ventricles, or where the growth is very large and sessile, the incision may have to be carried not only through the *alæ*, but even into the thyro-hyoid membrane. To secure still more room, horizontal incisions may be made through the crico-thyroid and thyro-hyoid membranes, close to the upper and lower borders of the thyroid cartilage respectively. Bleeding vessels should be caught up and tied one by one: as a rule, the hæmorrhage is not great, and is easily arrested provided there is free respiration. In old people, the cartilages are so ossified that a fine saw is required to cut through them.

The subsequent steps of the operation will be determined by the nature of the lesion. If a foreign body, such as a piece of mutton bone, be found impacted in the ventricle or between the cords, or partially embedded in the wall of the larynx, it must be carefully enucleated and any necrosed tissue around it scraped away. If a new-growth be found, it must be eradicated in one way or another. In operating on a child for extensive papilloma recently, the writer found it very difficult to seize hold of the growth, owing to the reflex excitability which the approach of an instrument set up, notwithstanding deep narcosis. The use of cocaine in such cases will materially aid the surgeon, and permit him to ascertain accurately the exact mode

and place of attachment. Evulsion with forceps is to be deprecated, for fear of injuring the vocal cords. If the growth is pedunculated there will be no difficulty: it may be snipped off with a pair of fine curved scissors. In young subjects, the growths are usually sessile and often multiple; they must be caught up with forceps, one at a time, and snipped off with fine scissors curved on the flat, as near to the base as possible, which should then be touched with chromic acid. In cases of laryngeal cicatrix leading to stenosis, with or without implication of, or adhesions between, the cords, no exact line of practice can be laid down. In one case seen by the writer there appeared to be a kind of keloid in the cicatrix, and the aphonia which had existed appeared to have been due to displacement of one vocal cord from this same cause.

After the removal of the foreign body or the morbid growths, and the arrest of all hæmorrhage, the edges of the thyroid cartilage are to be most carefully adjusted, for on this depends much of the success of the operation. Two or three fine silver-wire sutures should be used; they need not penetrate through the entire thickness of the cartilage. The skin-wound should be sutured separately, and then covered with a pad of wet boracic lint. A tracheotomy tube must be left in the lower part of the wound.

After-treatment.—Too great care cannot be exercised to keep the patient absolutely quiet. All attempts at speaking must be disallowed until firm union has taken place; coughing is very prejudicial, for the increased volume of air forced into the larynx, even while a tube is worn, is very apt to burst the alæ of the thyroid cartilage apart. Let the patient be provided with a slate and pencil, and make known his wishes in writing. The croup bed, with a supply of steam (as described in the article on TRACHEOTOMY), together with sedative inhalations, will be found of great advantage. Similar complications to those which follow tracheotomy may possibly occur, but they are much less frequent.

Prognosis.—The great danger of permanently interfering with vocalisation is a strong contra-indication to thyrotomy; hence the operation must never be undertaken when other measures are available. For morbid growths, the intra-laryngeal method of removal is now advocated by the best laryngologists, even in quite young children. Persistence and manual dexterity, they say, generally accomplish the

desired end. The time, however, which is required for the repeated trials, not altogether free from danger, the risk of converting simple into malignant growths by the long-continued irritation, the chance of failure in the end, the necessity, in many of the cases, for wearing a tracheotomy tube to relieve the dyspnoea, with all the risks which this entails, in the writer's opinion, render the more radical operation preferable, in the case of children at any rate. The improved methods of operating, the local anæsthesia, the more certain attainment of healthy healing, the knowledge gained by past experience and failures, render the re-consideration of the intra- and the extra-laryngeal methods for growths desirable. See LARYNX, Growths in the.

ROBERT WILLIAM PARKER.

TIBIAL ARTERIES.—THE POSTERIOR TIBIAL ARTERY runs from the lower border of the popliteus muscle, two and a half inches below the knee, downwards between the muscles of the calf and the deep group; it ends on the inner side of the ankle as low as a line drawn from the internal malleolus to the internal tuberosity of the os calcis.

The coverings, posteriorly, are the skin, superficial fascia, the muscles of the calf for the upper three-fifths of the leg; but at the lower part the cutaneous structures only. On the artery is the posterior tibial nerve, which is first on the inner side, then on the top, and finally on the outer side, at the ankle. Anteriorly, the vessel rests on the tibialis posticus, the flexor longus digitorum, the tibia, and a fatty envelope separating it from the ankle. Venæ comites accompany it. Around the artery and veins is a sheath continuous with the deep fascia of the leg.

LIGATION of the artery is performed for wounds only. The wound is taken as the guide, and incisions made from it in the course of the artery. On the dead body the following are practised.

1. *To Tie the Artery in the Upper or Middle Third.*—Ligation of the lower third of the popliteal may be done by a similar operation to that of the upper third, except that the incision is made behind the internal tuberosity of the tibia, and the soleus is not cut through.

Place the patient on the back, semi-flex the knee, and abduct the limb. The operator stands upon the outside of whichever limb is being operated on. Make an incision one finger's breadth behind the internal border of the tibia, opposite the upper

or middle third of the tibia—say the middle. Cut through skin; superficial fascia, avoiding the internal saphenous vein; the deeper fascia; pull back the free exposed edge of the gastrocnemius; detach or cut through the soleus; pull the nerve backwards, open the sheath, disassociate the veins, and pass the needle from behind forwards—i.e. between the nerve and the vessels. The soleus muscle requires attention. On dividing the soleus parallel to its fibres, an aponeurotic sheath is reached, tense and pearly; when this is cut through, muscular fibres are again found, and require separating before the deep fascia of the leg, covering over the deep muscles and enclosing the tibial vessels, is reached. The muscular fibres upon the under or anterior surface of the soleus increase in number from above downwards.

2. *At the lower third of the leg* the artery is covered only by cutaneous structures, and is easily reached. Lay the foot on its outside; point the toes; make an incision over the lower third of the artery midway between the inner border of the tibia and the inner border of the tendo Achillis. Here the artery is found with a fatty surrounding, the nerve lying upon it or just to its outside.

3. *At the ankle* the artery is reached by a curved incision two inches long, and three-quarters of an inch behind the internal malleolus. In addition to the structures met with above are:—the internal annular ligament, a plexus of veins of the internal saphenous, and the venæ comites remarkably large. The posterior tibial nerve is one-eighth of an inch to the outer side.

THE ANTERIOR TIBIAL ARTERY runs, from the bifurcation of the popliteal at the lower border of the popliteus muscle, forwards over the top of the interosseous membrane between the tibia and fibula. From thence it runs down upon the interosseous membrane in a line from the head of the fibula to the middle of the ankle.

Coverings.—There is but little fat present in the superficial fascia, in which are branches of the internal and external saphenous veins and nerves; the deep fascia is tightly fixed above, below, and to the bony ridges laterally; the muscles are, from within outwards, the tibialis anticus, the extensor proprius pollicis, the extensor longus digitorum.

Lateral Relations.—In the upper fourth the artery has the tibialis anticus on the inner side, the extensor longus digitorum outside. In the middle two-fourths the artery has the tibialis anticus internally, and the extensor proprius pollicis exter-

nally. Just above the ankle the artery has the extensor proprius pollicis within, and the extensor longus digitorum without. The *anterior* relations are the coverings; the nerve is at first to the outer side, then it lies on the artery, and at the lower part is slightly outside again; the tendon of the extensor proprius pollicis crosses the artery just above the ankle. *Posteriorly*, the artery rests on the interosseous membrane above, and the tibia below for the lower fourth of its length.

LIGATION of the vessel is performed for wounds of its trunk, and the operation is performed according as the wound is placed. The dead body operations are:—

1. *In the Upper Third.*—Semiflex the leg on the thigh, let the sole of the foot rest flat on the table, and adduct the knee slightly. In operating stand in front and make an incision in the guiding line for a distance of four inches. Cut through skin and superficial fascia. Then comes the question about the white line to be seen in the deep fascia; do not expect to see this white line, but cut through the deep fascia by an obliquely longitudinal cut or a crucial incision, and find out with the handle of the scalpel or director the separation between the muscles. Now flex the foot to relax the muscles, pull the lateral muscles outwards and inwards, open the sheath, avoid the nerve on the outer side, and pass the needle.

2. *In the Middle Third.*—Proceed in precisely the same way as above until the deep fascia is reached, when it is opened by a crucial cut. Then flex the foot on the leg, find the outer border of the tibialis anticus, and, entering the partition between it and the easily recognised tendon of the extensor digitorum, find the extensor proprius pollicis muscle. Pull the latter muscle outwards: carefully also pull the nerve to the outer side, open the sheath, and pass the needle.

3. *In the Lower Third* the artery is reached by an incision in the guiding line, which corresponds with the outer side of the tendon of the tibialis anticus. Do not carry the incision so low as seriously to cut the anterior annular ligament. The artery may be reached by pulling the exposed extensor proprius pollicis outwards or inwards. The nerve is pulled outwards as the needle is passed.

JAMES CANTLIE.

TIBIAL ARTERIES, Wounds of the.—Severe arterial hæmorrhage from the leg commonly occurs from the tibial or peroneal arteries, and may be considered as

arising under two distinct conditions—(1) hæmorrhage following amputation of the leg; (2) hæmorrhage following injury to the vessels in continuity.

(1) *Hæmorrhage following Amputations*.—Primary hæmorrhage occasionally gives rise to serious trouble in amputations of the leg, especially when performed through the upper third. This trouble does not, as a rule, occur in healthy subjects, but only in those whose arteries are brittle from atheromatous disease. The difficulty is a mechanical one, arising from the arteries lying between the bones rendering them difficult to seize with a forceps and to secure with a ligature. If the arteries are healthy, they may be drawn down somewhat, and by a little manipulation securely tied; but when diseased, they may be so brittle as to break away on each attempt to apply a ligature, making it impracticable to restrain hæmorrhage in this way, and necessitating an immediate amputation above the knee.

(2) *Hæmorrhage from Wounds of the Tibials in continuity*.—There are three chief varieties of wounds of the arteries of the leg—(1) incised wounds; (2) punctured wounds; (3) injury by a fractured bone.

Incised Wounds.—In these circumstances there can be no doubt that the bleeding vessels should be sought for and tied, for here, owing to the nature of the injury, the exact locality of the injured vessels is easily determined.

Punctured Wounds.—These, if occurring through the thick part of the calf or leg, give rise to serious questions in the matter of treatment.

Unpromising as the treatment may appear owing to the depth of the vessels, pressure and bandaging should be tried in the first instance, and cases are recorded in which this method has proved successful. For instance, in one case in which both tibials were wounded, it is mentioned that, 'on relaxing the tourniquet, and retracting the lips of the wound, the blood jetted up in several directions. It was found impossible to ligature the vessel without enlarging the wound to a considerable extent.' The limb was, therefore, bandaged from below upwards, and the patient recovered without further hæmorrhage. Again, another interesting case is recorded, in which a musket ball passed through the leg of a soldier three inches below the knee. Violent secondary hæmorrhage occurred, leaving the patient almost pulseless. The hæmorrhage was permanently arrested by pressure and bandaging, and the man recovered. Such

cases are encouraging, and at least indicate that a trial of pressure should be made. Should pressure fail, or a traumatic aneurism form, operative procedures must be resorted to.

In the lower third of the leg, where the vessels are superficial, the wound should be enlarged, and the vessel sought for and tied; but, in the upper part of a thick limb there is some question whether the enlargement of the wound is the best form of treatment.

If the wound has been inflicted by a long narrow missile or instrument, the position of the bleeding vessel is often doubtful, for the puncture may run obliquely in any direction; and it is even possible that the divided artery may be on the side of the interosseous membrane opposite to the external wound. Dupuytren, when writing of a case of hæmorrhage from the calf caused by a pistol ball, thus describes the difficulty:—'Should a ligature be placed on the ends of the divided vessels? But, what were those vessels? Was it the anterior or posterior tibial, or the peroneal, or the popliteal? Was it several of them at the same time? Should they be attacked before or behind?'

Billroth, in his letters from the seat of war, draws a graphic picture of the difficulties, and in some cases the impossibility of tying a vessel in a granulating wound. He concludes by saying that in most of such cases, after much loss of blood has been incurred in the attempt, the main artery has, after all, to be tied. Beck and Stromeyer also congratulate themselves on the successful result of ligature of the main vessel.

The writer can verify the opinion of these eminent authorities by what occurred in a case where he was present, in which the posterior tibial was sought for and tied in a punctured wound in a large calf. The operation was a most severe and prolonged one, and, although with the greatest difficulty the vessel was ultimately found, the patient never recovered from the shock of the operation, dying on the third day.

Of course, it may occasionally happen that hæmorrhage from the calf occurs from punctured wounds, which, from the nature of the instrument inflicting them, cannot be very deep. In such cases, the wound may be enlarged and the vessel sought for, but if the calf be thick and muscular, and if there be violent hæmorrhage from a punctured wound of unknown depth; or should bleeding occur from the bottom of a deep granulating wound, and the hæmorrhage cannot be restrained by pressure, the main artery of the leg in the nearest accessible

position—namely, in Hunter's canal—may be ligatured with a fair prospect of success.

Wound from a Fractured Bone.—It has been taught, by an eminent authority on modern surgery, that a fracture of the leg with laceration of the tibials is a case for immediate amputation, but when such surgeons as Cæsar Hawkins, Dupuytren, and Syme have successfully treated cases of simple and compound fracture, with hæmorrhage from one of the tibials, by the Hunterian operation, it cannot be admitted that all such accidents should be treated by amputation. If the patient be young and healthy, and the soft parts but little damaged, it would certainly be right to attempt to save the limb by compression or ligature of the main vessel. In an old person or one in whom the skin and soft parts were much involved, doubtless the right plan of dealing with the accident would be by immediate amputation. HARRISON CRIPPS.

TINEA FAVOSA. See FAVUS.

TINEA TONSURANS (*Synon.* Ringworm; Herpes Tonsurans; Tinea Circinata).

Definition.—Tinea tonsurans is a contagious disease, chiefly attacking the scalp in children, and producing partially bald scurfy patches. It is caused by a vegetable parasite called trichophyton tonsurans.

Ringworm was first noticed by Willan under the name porrigo scutulata, and was subsequently very accurately described from a clinical point of view by several writers, especially Plumbe and Mahon, before the pathology of the disease was discovered by Gruby in 1844. His discovery that the disease was due to a minute vegetable parasite was quickly confirmed by others, and has ever since been generally, though not universally, accepted by the profession. The same parasite is now known to produce the less common forms or rather distributions of ringworm, called parasitic sycosis and parasitic onychia.

Symptoms.—Tinea tonsurans on the hairy parts presents features somewhat different in appearance from the same disease when seen on other parts of the body, and therefore a brief description of each is necessary. *On the scalp*, it is commonly met with in the form of roundish scurfy spots, which itch slightly; rarely, a few small vesicles are seen round the margin of the spots. Soon the hairs begin to be affected, they lose their lustre and break off near the scalp so as to produce partially bald patches, the short, stumpy, broken hairs being visible over the part affected;

these stumps, which have frayed or bent and twisted ends, are of a rather darker colour than the healthy hairs, and give to the disease its characteristic feature. The general appearance of the patch, before it has undergone any treatment, has been not inaptly compared to the skin of a plucked fowl. On the scalp, ringworm spots sometimes occur singly; more commonly there are several, of sizes varying from a three-penny to a crown piece or larger: the larger patches often lose the rounded form. In some instances the patches spread rapidly at their margins, in others the process of development is comparatively slow. In addition to the breaking of the hair near its root, which is the *rule* in ringworm, there is also sometimes a shedding of the hair—that is, the hairs fall out with their roots attached; this is, unfortunately, quite exceptional. When it does occur thoroughly the disease gets well quickly, for with the complete shedding of the hair the fungus is also removed. Ringworm is quite unsymmetrical in its distribution, the spots being scattered about the head with marked irregularity; this is quite in accordance with the fact that it is strictly a local affection. Of course, in neglected cases the disease must tend to become symmetrical by the simple process of spreading over the scalp.

Tinea tonsurans of the hairy parts of the face is far from common; it now and then attacks the eyebrows of children who are suffering from ringworm of the scalp, but it is not very clear why this does not often occur; it is, in fact, rarely met with. Ringworm of the beard, constituting the parasitic sycosis of writers, is also a rather rare disease; when met with, it will generally be found that the sufferer is the father of children who have ringworm of the scalp. When the disease attacks the hairy parts of the face in adults, it causes more vesicular inflammation of the skin than is usually seen on the scalp in children, and for this reason is more likely to be mistaken for eczema. The diseased hairs sometimes fall off, but do not break off so readily as they do on the scalp, and therefore one valuable diagnostic mark is often absent. The patches spread at the margin and have a tendency to heal in the centre, and thus a ringed or serpiginous appearance is produced, which resembles a healing psoriasis. A similar condition is sometimes produced by ringworm about the pubes and scrotum, though in this country it is far from common in that region. All forms of ringworm of the hairy parts of the body are extremely

chronic and difficult to cure. When the disease spreads about the nates, as it sometimes does in those who follow sedentary occupations, such as shoemaking, and who sweat easily, it presents a well-defined raised margin, and hence was formerly called *eczema marginatum*, a term which ought now to be dropped out of use.

Tinea tonsurans of those parts of the body on which the hair is but little developed—such as the neck, trunk, and extremities—differs in appearance from the same disease on the scalp. On the body it is often called *tinea circinata*, but the name *tinea tonsurans* is to be preferred. It is usually seen in an early stage as a small round patch, or patches, of a slightly scaly appearance and of a pale red colour, with a sharply-defined and brighter red margin, which is a little more raised than the rest of the patch; as the patch increases in size, the central part assumes a comparatively healthy appearance, so that the spot becomes ring-like. Now and then a ring of small vesicles can be seen round the margin, and occasionally, though rarely, one ring forms within another, spreading apparently from a small central vesicle, and thus the so-called *tinea tonsurans* iris is formed. The general appearance of ringworm of the body is that of rounded patches of dry eczema with a well-defined margin and an unsymmetrical distribution; the itching is usually slight. Ringworm of the body is more difficult to diagnose than the same disease of the scalp, but is of much less importance, and is easily and quickly cured.

Morbid Anatomy of Tinea Tonsurans. For a general examination of the scalp, all that is required is a good-sized common magnifying glass; with this the diseased spots can be easily examined for affected hairs; two or three stumps should then be removed with a pair of forceps, and placed in a drop of liquor potassæ on a slide under thin glass, and examined with a good quarter-power under the microscope. The shaft of the hair will then be seen to be infiltrated and more or less split up with minute, round, bead-like bodies of about $\frac{1}{8000}$ th of an inch in diameter; these are the *conidia*, or *spores* of the fungus, and, in addition, very fine filaments or threads may be seen permeating the shaft of the hair. These threads are the *mycelium*; they are not quite so easily distinguished as the *conidia*. Dr. Frederick Taylor's observations lead to the conclusion that the fungus does not usually extend downwards beyond the upper part of the bulb of the hair, and

that, laterally, the spread of the fungus is limited to the inner root sheath, the *outer root sheath*, the *papilla*, and the *walls of the follicles* being free from fungus. Clinical observation would tend to confirm Dr. F. Taylor's microscopical observation, for when all the hairs fall out over a patch of ringworm (as happens sometimes naturally and sometimes from artificial causes), leaving smooth, perfectly bald patches, the ringworm is entirely cured by the complete removal of the fungus; this could hardly be the case if the fungus extended much beyond the limits assigned to it.

Etiology.—It is now generally admitted that the *trichophyton tonsurans* is the essential cause of ringworm in all its forms, and that the disease is highly contagious, especially amongst children. Although it is very natural to suppose that the spores of ringworm might be transmitted through the air and thus reproduce the disease, yet there is very little evidence to show that this is really the case. The effect of implanting the fungus on a suitable soil is that it grows quickly, and in a few days may set up a little local inflammation, which is the first noticeable sign of the disease. If the soil is unfavourable, the growth of the plant is more slow, or it may even fail altogether, as is no doubt generally the case with adults. As a rule, when overlooked, it spreads rapidly in schools and amongst the younger members of a family, while those over the age of sixteen or seventeen often escape altogether. There is a prevailing opinion that young infants are not so susceptible of the disease as older children; they are, however, quite as susceptible, but they are generally washed all over once or even twice a day, and therefore the spores have not the same opportunity of taking root; moreover, in infants, in consequence of the poorly-developed hair, the disease is easily cured by very mild home remedies without medical help. Mothers, for example, among the poorer classes in London, are quite successful in curing ringworm on babies with common ink, though they fail entirely with the older children.

It is not very easy to explain why ringworm should be much more common in some parts of Europe than in others. It is perhaps most common in England, and least common in Northern Germany. The most reasonable explanation appears to the writer to be, that a humid climate with a mild winter is favourable to the development of the disease.

There is very little doubt that *tinea tonsurans* is not confined to human beings,

but is also occasionally met with in the domesticated animals. The writer has met with several instances where the disease has spread from cattle to the arms and hands of men tending them; in all these instances the ringworm has been of a severe type, and has given rise to much inflammation.

The differential diagnosis of tinea tonsurans on the scalp is usually very easy. The scurfy, partially bald spot with short, bent, stumpy hairs is very characteristic, and in doubtful cases the microscope will always determine the point. On the hairy parts of the face the diagnosis is much more difficult, and a microscopical examination of hair is always necessary.

Under some circumstances, the diagnosis of ringworm of the scalp is a little difficult: (1) when complicated with moist eczema or impetigo, so that the hair gets matted together; (2) when the hair is shed very rapidly, leaving smooth bald patches, very like those of alopecia areata. In both these cases we must chiefly depend on a careful examination of hairs under the microscope.

When the ringworm is confined to the non-hairy parts of the body, the diagnosis is sometimes difficult. The patches look like dry scurfy spots of eczema or psoriasis; but, unlike these diseases, ringworm often consists of a single round spot spreading from a centre, and, even when several spots exist, they are generally arranged in an unsymmetrical manner. Again, the ringworm spot has a very narrow, slightly raised margin, often of a brighter colour than the rest of the patch; this bright edge is very characteristic of the disease. If the disease has not been treated in any way, some of the scales may be scraped off and examined in liquor potassæ under the microscope.

Treatment of Ringworm.—The number of different remedies that have been discovered from time to time for the cure of ringworm of the scalp is almost endless. Those that have been recommended by experienced observers are all good remedies, but they are not all equally good, therefore the business of the medical man is to choose the most suitable one for the case before him, being guided in his choice by the circumstances of the case, such as the duration and extent of the disease, and the age of the patient. Whatever discoveries may hereafter be made with regard to new remedies, the difficulties will always remain, and well-established ringworm will always be a tedious disease to cure. The difficulty arises entirely from mechanical

causes, which make it next to impossible to get the remedy in contact with the disease, this being, metaphorically speaking, under ground. The importance of this mechanical factor in the problem is well illustrated by the fact, that no disease is more quickly or easily cured than ringworm of the non-hairy parts of the body. In consequence of the very tedious nature of this disease on the scalp, patients often become the prey of quacks, in the vain hope that ignorant humbug will be successful where honest science has failed.

The *treatment* of ringworm in a very early stage is very simple, and consists in painting all the spots well over with the strong acetic acid. If the glacial acid is used it must be diluted with two parts of water, and applied carefully. If the ringworm is strictly confined to the surface, it may sometimes be cured in a few days by the strong acetic acid. Unfortunately, it very rarely is confined to the surface of the scalp, and therefore, after the acetic acid has been used for a week or fortnight, it should be discontinued, the sore places should be allowed to heal, and then a different plan of treatment should be adopted—namely, the inunction of an ointment. Of all the ointments that have been recommended, the writer has no hesitation in saying that the oleate of mercury is the most generally useful. It should be made by Dr. Shoemaker's double decomposition process. The pure oleate of mercury should be dissolved in melted benzoated lard, the temperature of which must not be much raised; the ointment may be used of different strengths according to circumstances, ranging from ten to twenty per cent. Before the treatment by ointment is begun, the hair should be cut quite short all over the head—as short indeed as is possible with a pair of scissors; this is better than shaving the head, because the spots of ringworm can be distinguished better when the head is not shaved. When the hair has been removed, the ointment should be *well rubbed* on all the spots night and morning. When an ointment is used, the head should not be washed oftener than once a week; if a lotion is used, it may be washed much oftener.

After the ointment has been used for some weeks, the process of epilation may be commenced, provided a fair number of hairs can be extracted entire: if nearly every stump breaks, it is useless to continue the process, but it should be tried again from time to time. The best plan of extracting is to take several hairs together,

and pull them steadily in the direction in which the hair grows; it is more easy to get them out this way than any other. If a mercurial ointment is inadmissible, the ointment of sulphurated potash of the P.B. may be used, but it must be often renewed, as it keeps badly. The oleate of copper ointment, of strength from one to three drachms to the ounce of lard, is a useful ointment and quite safe, but inferior to the oleate of mercury ointment; the bright colour is also a slight objection. Of lotions, that suggested by Dr. Cavafy is one of the best and least disagreeable, and is especially useful when the ringworm has spread rapidly over a large area, and is not of very long standing. By means of the lotion the area of disease may be greatly reduced, and then the obstinate spots may, if necessary, be dealt with by more vigorous treatment. The formula for the lotion is boracic acid ʒj., ether fʒj., rectified spirit to fʒvj. The lotion should be well applied with a small sponge two or three times a day. When using this lotion, there is no objection to the head being washed daily with warm soap and water, provided it is always carefully dried afterwards.

Disseminated ringworm is a very chronic form, in which the disease is scattered over the head in small groups or as single stumps, entirely concealed by the healthy hair round. This form of the disease requires especial care in its recognition and treatment, and can only be dealt with by Dr. Alder Smith's method, which he thus describes:—'In some inveterate cases—which have resisted the action of parasitocides—where all the patches have disappeared and the disease has passed into the *disseminated variety*, I believe the best chance of a cure is to subject the entire scalp to a very close examination with a lens, and to place, by aid of a *very* fine sable brush, a *minute* drop of croton oil wherever the isolated stumps or black spots can be seen. (A case where black dots are observed is one of the most difficult to cure.) If there are only a limited number, the oil can be pressed *into* the follicles by running the point of a very fine blunted gold pin into them by the side of the diseased stumps. The oil usually causes a pustule, and the loosened stump comes out with the discharge, or can afterwards be removed with a pair of forceps.'

The complications of ringworm are not many, but they are important—(1) Eczema and impetigo, (2) Kerion. Eczema and impetigo of the scalp are very troublesome additions to tinea tonsurans, for they

not only prevent the necessary treatment of the latter disease being carried out properly, but they often favour the rapid growth of the trichophyton. The best plan, under these circumstances, is to dry up the eczema as fast as possible, and when that is cured, deal with the ringworm chiefly by mild remedies, such as boro-glyceride and the extraction of the hairs by the forceps.

Kerion is a peculiar circumscribed swelling of the scalp due to an acute inflammation of the follicles, which become dilated and discharge a sticky fluid. The portion of the scalp affected forms a soft raised swelling, which feels boggy to the touch, and strongly suggests a subcutaneous abscess; and under the erroneous impression that this is the case a kerion has often been cut into, to the disappointment of the surgeon, who finds nothing. The kerion should be simply treated with a little lead lotion on lint, and when the inflammation subsides, the hairs over the part affected fall out and the ringworm is cured.

The preventive treatment of ringworm is very simple, but often very important in large families of small children. The writer, in common with others, formerly recommended carbolised glycerine and carbolised oil as preventives, but a more extended experience has satisfied him that these remedies are needless and disagreeable, and do not always answer the purpose intended; indeed, *nothing sticky or greasy* should be used. The best plan is to keep the hair very short and the head well washed every day with warm water and soap; this keeps the skin and hair dry, and at the same time hardly allows time for the ringworm to get established.

Medical Certificates.—It cannot be denied that it is often very difficult to say whether a case of ringworm is absolutely cured, so as to justify a *formal certificate* to that effect. This is not surprising, when it is remembered that a single remaining stump containing spores may form a centre from which the ringworm may break out again, perhaps weeks or months after it was believed to be cured. Even the most skilful and careful medical men must sometimes make mistakes in this matter. But besides these excusable mistakes, there are many more made from want of experience and want of care. No formal certificate ought, of course, to be given that a case of ringworm is cured without a most careful examination. Very unfair pressure is often brought by parents to bear on medical men, in order to induce them to give certificates prematurely that children are perfectly

cured and may return to school without risk to others. There are of course different degrees of risk; the greatest occurs in elementary boarding schools, where the children are young and consequently very susceptible, and have bedrooms in common, and where there is more or less indoor romping. Under these circumstances, even when the treatment is carefully carried out, there must be risks of the disease spreading. In the case of day-schools where the children do not play or sleep together, the risk, under careful treatment, is much diminished. In the case of lads of fourteen or fifteen under good treatment, who have separate bedrooms and studies, and whose active association with other boys is chiefly in outdoor games, the risk is reduced to a minimum; but in all cases it is the duty of the medical man to withhold a *formal certificate*, however slight the risk may be, until the case is quite cured.

ROBERT LIVEING.

TINEA VERSICOLOR. See **PITYRIASIS VERSICOLOR.**

TINNITUS. See **EAR, INTERNAL, Diseases of the.**

TOES, Amputation of the. See **Foot, Amputations in the.**

TOES, Dislocations of the. See **Foot, Dislocations of Bones of the.**

TONGUE, Diseases of the.—The diseases of the tongue will be treated in the following order:—

1. Congenital defects: atrophy; hypertrophy; tongue-tie. 2. Inflammatory diseases: acute glossitis; chronic superficial glossitis. 3. Leucoplakia (ichthyosis). 4. Eruptions or rashes: aphthæ; wandering rash. 5. Pigmentary affections. 6. Neuralgia: paralysis. 7. Tuberculous disease. 8. Syphilis. 9. Non-cancerous tumours in and beneath the tongue. 10. Cancer.

ATROPHY of the tongue may occur as a consequence of lesions affecting its motor nerve-supply. The wasting may be unilateral or symmetrical, and the degree to which it occurs will vary very much in correspondence with the cause. In ordinary hemiplegia the wasting may be scarcely noticeable; while, on the other hand, in disease of the medulla oblongata involving the hypoglossal nucleus, or after injury of the hypoglossal nerve, the atrophy may be considerable. The disease requires mention only here, as no question arises with respect to surgical treatment.

Congenital absence of the tongue is excessively rare, as are also defects of de-

velopment to a less extent, in the form of fissures or clefts.

HYPERTROPHY OF THE TONGUE (*Macroglossia*, *Prolapsus Linguae*) is a comparatively rare disease. Almost always beginning as a congenital affection, and in its early stages often overlooked, it may increase in severity until the tongue becomes too large to be retained within the mouth. It may even project beyond the level of the lips for two or three inches; the increased growth being helped by the irritation to which the organ becomes subject by its protrusion from the mouth, and its greater liability to be injured by the teeth. The hypertrophy may affect both sides symmetrically or one side more than the other. In the more severe cases, from exposure and constant irritation the mucous membrane becomes thickened and callous, and in some parts ulcerated from pressure on the teeth. The latter, after a time, become everted, from the constant pressure to which they are subject. In an extreme case, recorded by Chalk, the hypertrophied tongue had caused, by its weight, dislocation of the lower jaw.

The disease appears to be essentially a species of elephantiasis, consisting, as it does, of an overgrowth, especially of the lymphatic tissues of the organ. It is almost invariably an affection of infancy and early childhood. In Fairlie Clarke's table of forty-three cases, recorded by various observers, the disease was first noticed either at birth or before the age of six years in all but one; and in this instance the disease originated in mercurial glossitis and was therefore possibly not a true lymphangioma.

Treatment.—The best and only reliable treatment is excision of as much of the enlarged organ as may be necessary for enabling it to be retained within the mouth. The operation may be performed by the knife, écraseur, or galvano-cautery. The écraseur is probably the best. A couple of broad curved needles should be made to perforate the tongue immediately in front of the proposed line of section, and the wire or whipcord should be looped over and behind them. The after-treatment will be the same as after excision of the tongue for cancer. See **MACROGLOSSIA.**

In mild cases benefit has accrued from direct pressure by strapping; and in a case of Teale's by pushing the tongue back within the mouth, and keeping it there by an elastic band under the chin. But such measures are of very uncertain benefit.

True hypertrophy must not be confounded with the protrusion of the tongue sometimes seen in idiots and in cases of sporadic cretinism.

TONGUE-TIE.—Undue shortness of the *frænum linguae* is indeed a very rare affection. When it exists, the tongue cannot be protruded as far as the lower lip, and the act of sucking may be interfered with.

Treatment.—A snip of the *frænum* with blunt-pointed scissors is all the treatment required; the scissor-points being directed away from the under-surface of the tongue and towards the floor of the mouth, in order that the *ranine* artery may not by any chance be wounded. Before the application of the scissors the *frænum* should be stretched, either by the finger and thumb, or by means of the notched shield with which silver directors are usually provided.

Cases have been related in which the too free division of the *frænum* and subjacent structures has led to the sucking back of the anterior part of the tongue into the fauces, and consequent suffocation. It is difficult to believe that any such event could happen as the result of the operation, if properly performed. Similar accidents from undue length or absence of the *frænum*, or from malposition of the tongue, with defective development of the lower jaw and floor of the mouth, have been also recorded.

ACUTE GLOSSITIS.—Acute inflammation of the tongue may arise from direct injury, especially when accompanied by the introduction of some irritating or septic matter, as from a wasp-sting, or from puncture by a foul knife, from exposure to cold, or from the undue administration of mercury. It may occur also as a sequela of the eruptive fevers.

At first cedematous and thickly coated, the tongue becomes swollen and acutely tender. Subsequently, it may become dry and red, or even black. Besides filling the mouth, or nearly so, on its own account, it is commonly pushed up to the palate by inflammatory swelling of the subjacent parts. Unable to protrude or even move it, the patient is also more or less incapable, in a severe case, of speaking or swallowing, while respiration may be also much impeded. If unrelieved, the tongue may protrude beyond the level of the teeth.

Acute glossitis may end by gradual resolution, or by more or less well-defined suppuration; the symptoms being at once relieved on the escape of pus from the tongue itself or from the tissues beneath.

In very rare cases the inflammation may end in sloughing.

Treatment.—In a mild case of glossitis a saline purge should be given, followed by a draught containing gr. x.-xx. of chlorate of potash every four hours. The mouth should be frequently rinsed with a warm lotion of permanganate or chlorate of potash, or with a weak solution of carbolic acid (about 1 to 100).

If the swelling increase, the interior of the mouth should be carefully examined for any signs of localised suppuration; and a suspicion of fluctuation at any spot should be cleared up by puncture with a narrow abscess-knife, the operator having regard to the position of the main blood-vessels. If no sign of pus be detected, an incision of an inch or more in length should be made in the dorsum of the tongue, through the mucous membrane, on each side of the middle line; or the tongue may be punctured in several places. The incisions or punctures should be made sufficiently forward to be within reach in the event of undue bleeding. When the presence of pus is suspected, but where there is nothing to indicate its exact seat, a deep puncture may be made somewhere in the middle line either of the tongue or the anterior part of the floor of the mouth, and through this a probe-pointed steel director may be introduced for exploration. When the swelling is more especially in the sublingual tissues the exploratory puncture in the middle line may be made from without, between the chin and hyoid bone.

The more acute symptoms are usually relieved by the means just referred to; but the surgeon should be prepared, in a bad case, to perform laryngotomy or tracheotomy.

CHRONIC SUPERFICIAL GLOSSITIS.—*Glossy Tongue* (including so-called *dyspeptic ulcers*).—This is a very common disease; the morbid appearances presented by the tongue being due to repeated attacks of subacute inflammation, affecting the mucous membrane and submucous tissue. It is generally supposed to be, in most cases, of syphilitic origin; but we believe this to be a mistake, and that syphilis is accountable for only a minority of the cases observed. In the majority of cases of the disease, which is one chiefly of middle life, the predisposing causes are to be found in dyspeptic conditions, especially those which are the result of injudicious eating and drinking, while the disease is excited by local irritation—e.g. smoking, spirit-drinking, carious and foul teeth, and the like.

Sometimes, no sufficient cause can be discovered; but the disease will be always found to be aggravated by local irritation.

The appearances presented by the disease are very characteristic; the leading feature being an excessive smoothness or glossiness of the surface, as if all the papillary structures had been rubbed away. At one part the smooth surface of the tongue is red and as if raw; at another, not red but whitish, as if smeared with milk, or as if it had been touched with a solution of nitrate of silver. At another, there may be small, superficial, yellowish ulcers, or an irregular ulcerated surface, excessively tender to the touch or to anything hot or irritating. When at its worst the whole tongue may be swollen, and indented at the edges by the teeth. Here and there, remains of the proper papillary structure may be still visible.

The patient complains of much superficial pain and soreness, especially in the movements of the tongue in speaking or eating.

The microscopic characters of the disease are what might be anticipated from the naked-eye appearances. 'Expressed shortly, the changes consist in thinning of the epidermis, with destruction of the papillæ and other appendages; in thickening and increased vascularity of the corium, and infiltration of its superficial layers with nuclei or cells' (Butlin, *Med.-Chir. Trans.*, vol. lxi.).

Treatment.—Chronic superficial glossitis is a very intractable malady, and treatment should be directed rather to removing all the causes of an attack, and so preventing its recurrence, than to giving medicines with an expectation of quickly curing the disease by a specific. The mistaken notion that the disease is almost always syphilitic has had much to do, probably, with failures in treatment. The patient should live regularly and wholesomely, avoiding all spirituous liquors, and taking alcohol in any form with great moderation. He should not smoke; and if the teeth, natural or artificial, are not perfectly smooth and clean, he should have them made so as far as possible. Aperients (as blue pill and colocynth), with an occasional saline draught, should be taken, and any dyspeptic troubles should be treated.

The mouth should be rinsed occasionally with a weak carbolie lotion containing tincture of myrrh and eau-de-Cologne; and any ulcerated surface may be painted with a solution of sulphate of copper (gr. iij. to

fʒj. of water), or chromic acid (grs. x. to fʒj. of water).

As a rule, the administration of iodide of potassium or of mercury will do no good, and may even do harm. But as it is not easy in all cases to distinguish simple superficial glossitis from that which has a syphilitic origin, these drugs should be tried in any doubtful or intractable case, not in ordinary routine fashion, but as supplementing the other measures referred to.

As in the case of all long-standing irritating affections of mucous membrane or of skin, chronic superficial glossitis may be followed by the formation of epithelial cancer. (See *Leucoplakia*.)

LEUCOPLAKIA.—*Ichthyosis, Psoriasis, Keratosis, Tylosis.*—This disease of the tongue, best termed *leucoplakia*, has attracted much attention during the last few years, chiefly on account of the fact, to which notice was first drawn by Hulke, that it not infrequently develops into epithelial cancer. The dorsum of the tongue is more or less covered, usually in a symmetrical fashion, by whitish patches, which, however, may vary much in size and appearance in different cases. In the milder cases, the tongue looks as if it had lost its papillæ, the surface being, in the part affected, more or less dry, smooth, and milky-white, with an appearance, often, of minute cross-hatching. In the least marked cases, indeed, there is little, if anything, to distinguish it from the effects produced by long-standing chronic superficial glossitis. The disease may, however, present appearances in different cases, varying from a mere 'miliness' of the surface to a thick dead-white or yellowish covering, which, to the finger passed over it seems rough, or even prickly, and which reminds one, in its general aspect, of the sodden epidermis of the palm of a hand after long poulticing, or of a piece of rough and discoloured chamois leather. A similar appearance, but less marked, is very commonly seen on the mucous membrane of the cheek, especially just within the corners of the mouth, and extending from this part along the mucous membrane for a longer or shorter distance. The general appearance of the patches, especially in the milder cases, may vary in the same individual from time to time, probably in correspondence with the care taken to avoid all local irritation, as by smoking and drinking.

Differing so much as the cases do in their naked-eye characters, it is not astonishing that the microscopic appearances are found to differ also. Thus, in Hulke's

case of thick, tough, raised patches, to which alone (if ever) the term *ichthyosis* is applicable, the microscopic appearances were those of 'extreme hypertrophy of the filiform papillæ and their sheaths. These composite papillæ had an average diameter of 0.1 inch at their base and the average length of 0.25 of an inch. The epithelial sheaths of the secondary papillæ, instead of ending separately in brushes, cohered in solid masses' (Hulke, *Trans. Clin. Soc.*, vol. ii.). In cases of the mildest type, on the other hand, the microscopic appearances are indistinguishable from the effects of chronic superficial glossitis, and may be considered identical with them. In other cases, again, both mucous membrane and epithelium are thickened; but there is no extreme hypertrophic condition of the papillæ on the one hand, nor any marked effacement of them on the other (Goodhart; Sangster).

Unless the mouth be irritated, as, for example, by smoking and drinking, in which case the symptoms resemble those of chronic superficial glossitis, the disease may remain for many years without causing any notable trouble. Its importance, however, lies in the fact that after a variable number of years—it may be ten, twenty, or thirty, or more—the disease may develop into epithelioma, the latter being, in the author's experience, usually of the superficial, warty kind. In how many cases of leucoplakia epithelioma supervenes, it is impossible to say—possibly in only a small minority, as the milder forms of the disease are not rare, and, giving rise to no symptoms, would only come by accident under the notice of the surgeon.

With regard to the origin of the disease many causes have been assigned—syphilis, smoking, drinking, hot foods, and all other irritants. These, indeed, make the disease worse, and may act possibly as exciting causes; but it frequently exists without any such antecedents being discoverable. The disease is much more common in men than in women. See PSORIASIS BUCCALIS.

Treatment.—The most important treatment lies in the careful avoidance of everything which may irritate the mouth or make it foul. The patient should abstain from smoking and from all spirits; he should live on plain wholesome food, with little or no wine or beer; care should be taken that no source of irritation is present in the shape of carious or sharp-edged teeth or in connection with artificial teeth. Mild cleansing or alkaline lotions may be used, if necessary. Any persistently

ulcerated spot should be removed by the knife, or destroyed, if very limited in extent, by nitric acid. The pain produced by the latter is not so great as might be anticipated, and may be almost abolished by the previous application of a 20 per cent. solution of cocaine (T. Smith).

APHTHÆ.—The tongue shares, with the inside of the lips and cheeks, a special liability, especially in infancy and early childhood, to the formation of small whitish spots or ulcers commonly termed *aphthæ*. Two varieties of this affection may be fairly differentiated one from the other—viz. (1) simple follicular or aphthous stomatitis, and (2) thrush.

(1) *Aphthous Stomatitis* is characterised by the appearance of small yellowish vesicles, which soon break and leave superficial ulcers, of about the size of a pin's head, with a whitish or yellowish surface and sharply cut edge with vivid red areola. Such ulcers, which may be single or multiple, are usually acutely tender, and cause much pain when, in the movements of the tongue in speaking or eating, they undergo friction against the teeth. Although most common in early life, follicular stomatitis in a mild form is not rare in adults, and, in both cases, is commonly associated with a furred tongue and other indications of a disordered condition of the digestive organs. In a severe case, the little ulcers may, some of them, become confluent and assume the form of so-called *ulcerative stomatitis*; but this condition is less common in the tongue than in the gums and inside of the cheeks, when it sometimes rather closely imitates the appearances seen in true *cancrem oris*. See STOMATITIS.

Treatment.—Saline aperients, followed in an adult by the administration of dilute mineral acid in a bitter infusion, form the best constitutional treatment; and the mouth should be rinsed occasionally with a lotion of borax (gr. xx. ad f3j. of water) or carbolic acid (1 to 100), and containing a little eau de Cologne.

Chlorate of potash is almost a specific for *ulcerative stomatitis*, and should be administered internally in gr. v.–x. doses, as well as applied locally in a saturated aqueous solution.

(2) *Thrush.*—The characteristic small whitish or yellowish spots in 'thrush' are much more numerous than in simple follicular stomatitis; the tongue and other parts affected looking as if thickly dotted over with tiny particles of curd, which in severe examples of the disease may coalesce and form patches of false membrane. The

white spots are firmly adherent to the mucous membrane, and when peeled off leave the surface red and sometimes abraded. There is some heat as well as tenderness in the parts affected.

Thrush is especially a disease of infancy (although it is met with sometimes in the course of wasting diseases of adults), and is almost invariably associated with disordered nutrition; the little patients being more or less emaciated, and frequently suffering from diarrhoea, with green and fetid motions. Although thrush depends essentially on disordered nutrition arising most commonly from improper or insufficient food, there is no doubt of its being immediately associated with the development in the diseased epithelium of a microscopic vegetable fungus (*oidium albicans*), which, if it does not constitute the essential cause of the local disease, may be considered to aggravate its symptoms.

Treatment.—The predisposing causes of 'thrush'—insufficient or improper food, sour milk, want of cleanliness in regard to feeding-bottles and other vessels—and the diarrhoea which ensues as a consequence, all suggest the general treatment which is in most cases requisite. Local treatment is also important. Dr. West advises that the mouth should be carefully wiped out with a piece of soft rag dipped in a little warm water after every time food has been given, and that, afterwards, a lotion of borax (gr. xx.-3ss. to f3j. of water) should be applied. If the borax seem insufficient, a mild carboic acid lotion (1 to 100 of water), or one containing permanganate or chlorate of potash, may be employed. In adults, aphthous ulceration of the tongue, whether associated or not with the presence of *oidium albicans*, is a painful affection, and is usually met with in the last stages of wasting diseases, as cancer and tubercle. Various remedies are usually required for its treatment; sometimes one appearing to answer best and sometimes another. In addition to the means above-mentioned a lotion of sulphite of soda (3j. to f3j. of water) may be tried; or a lotion containing glycerin boracic and water in various proportions. In some cases, when the tongue is very dry, great comfort is given by painting it with a camel's-hair brush dipped in pure glycerine (Cotter).

WANDERING RASH.—This very rare disease, the first account of which, in this country, we owe to Mr. Arthur Barker (*Pathological Soc. Trans.*, vol. xxxi.) is characterised by the appearance of small circlets or crescentic bands of light-coloured 'rash.'

These extend rapidly, and wander from place to place centrifugally over the dorsum and occasionally the borders and under-surface of the tongue; what was only a round whitish or yellowish spot in the morning may have become a large ring in the afternoon, and have totally disappeared a few hours later. Itching and salivation sometimes accompany it, and form its leading symptoms. In some cases it causes scarcely any symptoms, and the patient may be unaware of its existence. Its resemblance in appearance to ringworm is very striking, but the disease appears, from Barker's observations, to be not parasitic.

With respect to prognosis, there appears to be nothing to fear beyond the discomfort arising from the itching; no serious sequelæ having been noticed, even in cases in which the disease has lasted for some years.

Treatment, whether local or constitutional, has little or no effect on its progress.

PIGMENTED TONGUE.—Of pigmented tongues there are several varieties. In one of the most marked (*black tongue*) the disease appears in the form of an oval or circular patch placed in the middle line of the dorsum, and is caused by the deposit of some black material in the thick epithelial investment of the papillæ, especially the filiform, which may be at the same time abnormally elongated. The black patch may vary in size at different times; in some instances almost the whole of the dorsum being affected. The cause of the disease is unknown. It gives rise to no symptoms as a rule, and requires no treatment.

In another variety of black tongue the disease takes the form of small black dots and patches, most marked on the edges of the tongue and seated apparently rather in the corium than in the epithelial cells. Similar dots and patches may be seen on the tongue in Addison's disease. The possibility of black tongue being produced by an intentional or accidental application of colouring matter by the patient, should be borne in mind.

Xanthelasma of the tongue is very rare; but a well-marked case has been not long since reported by Dr. Wickham Legg, in which the disease appeared not only in some of the more usual situations, but also in the form of yellowish, slightly raised patches on the sides of the tongue.

NEURALGIA.—Neuralgia, affecting the tongue chiefly or exclusively, is a rare disease. It does, however, occasionally

occur, and, like cases of the same affection in other parts, may be exceedingly obstinate under all treatment. Beyond the measures which would be tried as a matter of course, such as large doses of quinine and careful attention to anything wrong in the general health, may be recommended the local application of menthol (Butlin) or of solution of cocaine, four to twenty per cent., or the local injection of morphia, beginning with a small dose only (gr. $\frac{1}{8}$ or $\frac{1}{6}$), and cautiously increasing it if necessary.

If the disease does not yield to these measures, the operation of stretching or division of the gustatory nerve may be performed. *See* GUSTATORY NERVE.

TUBERCLE: LUPUS.—Tuberculous or scrofulous ulceration of the tongue is a rare disease, although possibly less rare than is generally supposed, on account of its not being sufficiently distinguished from the much more common syphilitic and cancerous affections of the organ. It usually presents itself in the form of an œdematous, glazed, inflamed ulcer with yellowish surface, very tender, but not fissured or warty or sloughing, or suggesting the idea of much new-growth. In almost all cases the patient is the subject of other scrofulous manifestations. There is either scrofulous or lupoid ulceration in the throat, or supuration of a like kind in the cervical glands, or the patient is the subject of advanced phthisis—laryngeal or pulmonary. The tip and edges of the tongue are favourite sites for the tuberculous ulcer, but it may attack any part of the organ.

Diagnosis.—The only form of syphilitic ulcer, with which the tuberculous is likely to be confounded, is the tertiary or gummatous; and from this the diagnosis is not very difficult, if the history and accompanying conditions are carefully considered. The tuberculous ulcer is usually much cleaner than the syphilitic; the glazed and raw surface being more like that of an ordinary inflamed but sluggish and irregular wound, produced by some injury. The acute tenderness of the ulcer is also characteristic, especially when it involves the tip or edges, and is more likely to lead to the disease being confounded with a cancerous than a syphilitic ulcer. The absence of other evidences of syphilis is also important, and last, but not least, as a diagnostic indication, is the failure of iodide of potassium to give any marked relief. Frequently, the early age of the patient affords help in diagnosis.

The diagnosis of tuberculous ulceration from cancer is not always easy; the pain

and distress in both being often very great, and the failure of all remedies to give relief being about equally marked. But in the tuberculous tongue there is less evidence of infiltration by new-growth; its general aspect being rather that of an irregular inflamed *ulcer* than of *tumour*. There is comparatively little adhesion of the tongue to neighbouring parts, even when the disease has long existed; and although remedies give but little relief, the progress to evil in the scrofulous ulcer is much less rapid.

A valuable means of diagnosis may also be afforded by gently scraping the surface of the ulcer, and examining the specimen mixed with a drop of water under the microscope.

Treatment.—The general treatment of scrofulous disease in the tongue is identical with that which would be appropriate to tubercle in the larynx or lung. For local treatment see *Palliative treatment of Cancer of Tongue*. In a case in which the disease is well-defined and comparatively limited, erosion by means of a Volkmann's spoon, followed by the application of nitrate of silver or of iodoform, may be tried. Excision is sometimes, though rarely, advisable.

Lupus vulgaris affecting the tongue may be considered to be included in what has been said regarding tuberculous disease. So far as any diagnosis between the one form of strumous disease and the other is possible, it will be found in the presence or absence, at the same time, of lupus of the face or nasal passages or pharynx. The treatment is the same for both.

SYPHILIS.—Syphilis affecting the tongue may take the form of—(a) chancre; (b) condylomata or mucous patches, or superficial irregular ulceration; (c) tertiary syphilitic deposits (gummata) or ulceration.

(a) Chancre is exceedingly rare, and needs only to be mentioned.

(b) Condylomata and mucous patches are almost always accompanied by similar manifestations of syphilis in other parts of the mouth and elsewhere, as on the penis and about the anus. They require no special description. When not in the form of condylomata, secondary syphilitic ulceration of the tongue takes the form, usually, of an irregular whitish or yellowish superficially ulcerated or abraded surface, especially along the edges. The tonsils are usually ulcerated at the same time, and the corners of the mouth may be fissured.

With regard to treatment, it will suffice here to say that mercury should be cautiously administered either by the mouth

or by inunction. *See* INUNCTION; SYPHILIS. Much benefit will be produced also by local treatment, as by painting with a solution of chromic acid (gr. x. ad fʒj. of water) or a solution of the cyanide of mercury (gr. xv. to fʒj. of water).

Ulceration of the tongue produced by the injudicious administration of mercury may be confounded with syphilis, and is often associated with it. The foul breath, the spongy gums, the cedematous and indented tongue, with the history, will guide to a correct diagnosis; which will be confirmed by the good effects of a saline purge, with cleansing lotions, as of chlorate of potash (gr. x. ad fʒj. of water) or carbolic acid (1 part to 100 of water with a little eau de Cologne).

(c) Tertiary syphilis of the tongue usually takes the form of gummata, which may or may not be ulcerated or sloughing. When the surface is unbroken, the disease, in the form of tough nodules or tubercles, may be situate in any part of the tongue, but rather on the dorsum than the edges. These are very irregular both as to number and individual size, and are not commonly either very tender or painful. Sometimes, they are crowded together so as to give to the tongue a very irregular surface, with apparently deep furrows or fissures; but the latter are not necessarily ulcerated or even abraded. When no ulceration or abrasion is present, such a tongue may give the patient but little trouble; while at another time there may be considerable distress in consequence of some glossitis and superficial ulceration, with temporary enlargement of the tubercles and apparent deepening of the fissures. In another case, the gumma may slough or ulcerate, leaving a deep cavity with irregular walls and up-standing edges; the general appearance sometimes closely simulating malignant disease.

As a rule, the diagnosis between syphilis and epithelial cancer is not difficult. The best diagnostic signs of syphilis are—(a) the comparative absence of pain and of tenderness, especially on making firm pressure; (b) the tongue is not fixed by adhesions even in severe cases of syphilis; (c) tertiary syphilitic ulcers are usually in some part of the dorsum rather than on the edge, and are not usually single; the remainder of the tongue is also commonly more or less affected; (d) there is no marked salivation from reflex irritation; (e) a syphilitic tongue, likely to be confounded with cancer, should be *rapidly* and greatly benefited by the internal administration of iodide of potas-

sium; (f) the presence or absence of any history of primary syphilis should be also duly (but not unduly) weighed in making a diagnosis.

Treatment.—The treatment of tertiary syphilis of the tongue lies in the internal administration of iodide of potassium, either by itself or combined with small doses of mercury. Calomel vapour-baths, if carefully given, are also useful; or mercury may be given by inunction. *See* INUNCTION; SYPHILIS. The local treatment is the same as that advised for secondary syphilitic ulceration. It frequently happens that a long-standing disease of the tongue, which is undoubtedly in its origin and even in appearance syphilitic, is really not syphilitic, and requires quite different treatment from that just mentioned. Tongues scarred and tuberculated by old syphilitic ulceration may never regain their normal texture, although the syphilitic element fades away by lapse of time, or is cured by treatment. Such tongues are easily irritated by injudicious eating and drinking into an extremely sore and troublesome condition, and the patient gets little or no benefit, and may even get harm, from the quantities of iodide of potassium or of mercury which are being constantly taken. Such cases require treatment identical with that mentioned under the head of *Chronic Superficial Glossitis*.

NON-MALIGNANT TUMOURS. — Tumours of the tongue (using the term in its usual sense) are almost always cancerous. But others are occasionally met with. Simple wart or papilloma, mucous, hydatid, and other cysts, fatty and fibrous tumours, keloid, enchondroma, and sarcoma have been all recorded. All are rare, and space permits here only mention of them.

NÆVUS.—Nævus of the tongue is a somewhat rare affection. It presents no difficulty in diagnosis; the general appearance and characters resembling very much those which are so familiar in the case of the skin. The purplish smooth swelling, dotted here and there with red, which disappears on pressure and quickly reappears when the pressure is removed, without hardness or pain or tenderness, can scarcely be mistaken for any other disease. As a rule, nævi give no trouble, and but rarely require any treatment; and unless they cause inconvenience by their size or bleed from injury by the teeth, they should not be interfered with, especially as they share, with similar growths in the skin, a tendency to wither as age advances.

Occasionally, it is necessary to remove a nævus, and, in this case, the knife or scissors may be employed if the tumour is small; the operator, after securing the tongue by a thread passed through its tip, cutting into the sound tissue around the nævus, and not, if it can be avoided, into the nævus itself. In cases of more extensive disease, removal by the *écraseur* is preferable, the operation being planned after much the same fashion as for other tumours. In some cases, the application of the actual cautery or galvano-cautery to the nævus, as in the case of some nævi of the skin and subcutaneous tissue, is advisable, in lieu of the more complete removal by the knife. Paquelin's cautery is convenient for the purpose; one of the more pointed instruments, at a dull-red heat, being introduced, here and there, for a few moments into the substance of the growth.

Cirroid aneurism of the tongue is very rare. In a case recorded by Sir Joseph Fayrer, which bore a superficial resemblance to a large ranula, and which was subject on occasion to severe hæmorrhages, much benefit was obtained from the injection of a strong solution of tannic acid.

WARTY TONGUE.—*Sago Tongue.*—A rare but well-marked disease of the tongue is sometimes seen in which the organ is at one part warty or papillated; the individual projections, however, not looking like enlarged lingual papillæ, but having a gelatinous semi-transparent aspect, not unlike boiled sago-grains. The part of the tongue affected is generally thickened.

Unless, by chance, the tongue is bitten from its projecting between the teeth, no symptoms are perceptible by the patient, and the disease may be discovered only by accident.

The disease is probably, in its origin, nævoid; the peculiar appearances observable being caused by a degeneration of the nævus structure. No treatment is required.

CANCER.—Cancer of the tongue, which may be said to be always epitheliomatous, may begin either as a small lump or warty tubercle, or as a small ulcer or fissure, with hard edges, and tender on pressure. Unfortunately, it is only in a small minority of cases that the surgeon is called upon to diagnose the disease at a very early stage. Much more frequently, the disease is more advanced when the patient seeks relief, and is then in the form either of a warty or ulcerated mass, which projects slightly from the surface but is connected with it by a broad base, which dips down more or less

deeply into the substance of the tongue; or, on the other hand, in the form of a well-defined ulcer, somewhat excavated, with hard edges, which seem infiltrated in the substance of the tongue. As the disease extends, it gradually encroaches on neighbouring parts, infiltrating not only the muscular substance of the tongue, but the mucous membrane and other structures which form the floor of the mouth, and even the gum and the lower jaw.

The mobility of the tongue is by degrees more and more interfered with, as it becomes bound down by the encroachments of the disease on neighbouring structures. Speech, mastication, and deglutition are all painful and difficult. Apart from any movement, moreover, the tongue is the seat of acute neuralgic pain, which radiates to other parts, especially to the ear and side of the head; while, by reflex excitation, the salivary and mucous glands are stimulated to secrete profusely. The lymphatic glands beneath the jaw are usually more or less enlarged and tender, when the disease in the mouth has begun to give rise to much pain and irritation; but in the early stages of the affection this symptom may not be present.

Diagnosis.—The diseases with which cancer of the tongue is most likely to be confounded are—(1) tertiary syphilis, (2) tuberculous ulcer, (3) simple ulcer from irritation.

(1) From syphilis, cancer is best distinguished, at an early stage, by its hard edge and excessive tenderness, the patient wincing on even moderate pressure; while, a little later, the tendency to adhesion of the tongue to neighbouring parts, the increasing pain of a neuralgic character, radiating to the jaw and side of the head, the extreme tenderness, with largely increased secretion of saliva, leave but little doubt as to diagnosis, even apart from the extent, very various in different cases, to which the infiltration by new-growth and the destruction by ulceration have extended. If the neighbouring lymph-glands are enlarged, there may be the less doubt regarding the nature of the disease; but the absence of such enlargement counts for very little at an early stage, and should be disregarded in making a diagnosis.

Absence of history of primary or secondary syphilis is, of course, to be counted as a diagnostic sign in favour of the malignant nature of the disease; but its presence should be reckoned as of slight value only in a case which, on other grounds, seems cancerous. A patient who has suffered

from syphilis is not *less* likely to have cancer than another.

(2) From the tuberculous ulcer, cancer may be best distinguished by the symptoms mentioned in connection with the former.

(3) A chronic simple ulcer, produced by irritation from a sharp tooth or artificial tooth-plate, or the like, may occasionally give rise to a suspicion of the presence of cancer. The absence of a hard edge or base will usually distinguish it; and, with proper care, the presence of anything in the mouth likely to cause such an ulcer will not be overlooked. Care should be taken, however, not to treat too lightly any apparently simple ulcer; inasmuch as a cancerous sore may, at its beginning, attract a patient's notice in consequence of friction, which to a healthy tongue would have been imperceptible.

In cases of doubtful diagnosis between cancerous and other ulcerations of the tongue, valuable help is sometimes got by gently scraping the surface of the ulcer, and examining what is obtained under the microscope. In the case of a non-cancerous ulcer, only elements will be found such as might be afforded by any simple ulcerating surface, 'pus and blood-corpuscles, débris of food, schizomycetes, and even epithelium. But the epithelium bears no resemblance to that derived from the cancerous ulcers. It is well formed, of more equal size, and regular shape—not granular, and the nuclei are exceedingly small in comparison with the large size of the cells.' On the other hand, 'the scrapings of cancerous ulcers contain always numerous epithelial cells, in addition to pus- and blood-corpuscles, and débris of food, and schizomycetes. But the epithelium differs widely from the healthy epithelium of the tongue. The cells vary much in shape and size, and often present singularly distorted forms; their nuclei are always much larger than those of normal cells, and sometimes there are several nuclei or even nucleated cells within the larger cells; while a greater or less quantity of granular material always occupies the interior of the cells. Not infrequently cell-nests or fragments of cell-nests may be observed' (Butlin).

The *microscopic appearances* of epithelioma of the tongue resemble very closely those seen in the like disease of other parts of the body. 'Processes of epithelium dip down from the epidermis into the subjacent textures. These processes, however numerous they are or large they may become, do not usually combine to form a continu-

ous mass or solid block of epithelial cells, but become connected at short intervals by horizontal bars of cells, so as to enclose what look like areas of irregular form. These areas are really spaces, communicating freely between the anastomosing bands of epithelium, filled with the altered tissues of the tongue, infiltrated with leucocytes.' 'Cell-nests may be discovered without difficulty in almost every epithelioma of the tongue. Often large and well-formed, they rarely present the horny and finely-stratified appearance of similar structures seen in squamous carcinoma of the skin, but rather resemble the cell-nests which may be observed in the epidermis of the normal tongue' (Butlin).

The *duration of life* in cases of epithelioma of the tongue is very different in different instances. It may be measured sometimes by a few months, in other examples by many years. In a very few we may hope that the disease has been, by surgical operation, completely eradicated. When fatal, the disease almost always destroys by long continuance of pain, discharge, and interference with the swallowing of food; the end being hastened in many cases by hæmorrhage from vessels, of larger or smaller size, laid open in the course of the extending ulceration. Occasionally, a low form of septicæmic pneumonia, with partial destruction of lung-tissue, occurs—possibly the result of direct irritation of the lung by inhalation of matter from the foul discharging surface of the cancerous ulcer.

Treatment.—The question of treatment of cancer of the tongue resolves itself, in the first place, into whether the given case is one fit for surgical operation; and the reply may be briefly summed up by saying that the disease should be removed in all cases, in which complete removal is possible without undue danger to the life of the patient. There are many cases, too, in which it is advisable to remove the disease, even when it is not possible to be sure that the removal is *complete*. This point will be referred to hereafter. When possible, diseased lymph-glands should also, of course, be removed.

Palliative Treatment.—Many cases of cancer of the tongue are seen too late in the progress of the disease to permit the performance of any operation for its removal; and in some instances recurrence will occur *in situ*. The palliative treatment of all such cases is, therefore, most important, and although little can be done to delay the progress of the disease, very

much can be done often in the way of alleviating pain and distress.

(1) Very frequently it will be found, on examination, that the ragged and ulcerated surface of the cancer corresponds exactly in position with the neighbouring teeth, although the latter may be neither irregular nor carious. In such cases, great relief will be given by administering an anæsthetic and extracting all the teeth (sound or unsound) which touch, or in future are likely to touch, the cancerous mass.

(2) In cases in which the pain seems, from its character and distribution, to be caused by pressure on the gustatory nerve, great relief may be afforded by division of the latter in the manner recommended by Hilton or by C. H. Moore. *See GUSTATORY NERVE.*

(3) Among minor measures for the relief of pain may be mentioned the frequent cleansing of the mouth with lotions containing permanganate of potash, carbolic acid, or the like. Sometimes a lotion of citric acid (gr. x.-3ss. to f3j. of water) is serviceable, or the same remedy may be used in the form of small slices of lemon. Iodoform may be also occasionally dusted on the ulcerating surface.

(4) In some instances, acute pain at particular spots may be relieved by the application of the actual cautery, which acts, doubtless, by the destruction of fine nerve-filaments which are exposed in the course of the ulcerating process. For that purpose the cautery should be used at a dull-red heat, so that hæmorrhage may not be produced by the too quick destruction of the parts to which it is applied.

(5) Insufflation of the surface of the painful part with some such powder as the following has been lately strongly recommended by Butlin:—Borax, gr. iij. or gr. iv.; iodoform, gr. j.; morphia, gr. $\frac{1}{4}$ to gr. $\frac{1}{2}$.

(6) As a rule, the application of ice and of gentle pressure will suffice for moderate hæmorrhage from an ulcerated cancerous surface within the mouth, aided, if necessary, by some styptic, as perchloride of iron, carefully applied to the bleeding spot. It but rarely happens that ligature of the lingual artery is demanded.

The internal administration of opium and of other narcotics needs no detailed description. The surgeon must be guided by the special needs of each case.

W. MORRANT BAKER.

TONGUE, Operations for removal of the.—When the amount of disease is very small, and in the anterior part of the tongue,

the method of removal is very simple. A strong thread should be passed through the tongue about an inch behind the tip, on the side opposite to that affected, and the little tumour or ulcer, having been seized by vulsellum forceps, may be cut out, with a good margin of healthy tissue, by the knife or strong curved scissors. If the operator prefer it, he may use the *écraseur*, taking care to pass one or more stout curved needles at a good distance behind the disease and in front of the *écraseur*, so as to ensure a free removal. In most cases, however, a less simple proceeding is required.

In choosing from among the various operations which have been recommended for removal of all but the smallest cancers of the tongue, the surgeon should adopt that which, in his opinion, will best enable him to remove the disease completely, without undue danger to the life of the patient.

Space admits here of a description only of those operations which are now usually practised.

(1) For the majority of cases the writer believes that the following method, which he suggested in the *Lancet*, April 10, 1880, is the best:—After the introduction of a suitable gag, and the removal of any sharp or jagged teeth which might be in the way of the operator, two threads are passed through the tongue about an inch behind the tip and half an inch on each side of the middle line. The tongue being now drawn forwards and upwards, the frænum and, as far as it may seem necessary, some of the muscular attachments of the tongue to the lower jaw in front are now snipped through, as advised by Sir James Paget, with strong, blunt-pointed scissors; and the scissors are then 'run' along the floor of the mouth at the side, beneath the mucous membrane, as far back as may seem requisite, keeping close to the lower jaw both for the avoidance of hæmorrhage and for the sake of being clear of the disease. The operator now with his forefinger clears the tongue in front and at the sides, and drawing it well forward again, and giving one thread to his assistant while he holds the other himself, he cuts steadily along the middle line of the tongue from the tip backwards, and farthest along the mucous membrane. On the withdrawal of the knife the finger is now again introduced, and it will be found quite easy to complete with it the median division of the tongue by a little tearing or splitting between the two halves. The only part which cannot be thus torn is the mucous membrane of the dorsum. Hence

the advice just given to divide this with the knife as far as may seem necessary for getting beyond the level of the disease. The *écraseur* is now slipped over the diseased half of the tongue. This is, of course, one of the most important parts of the operation; any want of care at this stage being shown afterwards by the narrow margin of healthy tissue, or by none at all, left attached to the diseased mass. The insertion of one or of two curved needles well behind the disease before the application of the *écraseur* in order to ensure the division of healthy tissue, is advisable, but, for the reasons previously given, must not be considered a sufficient safeguard in the absence of free separation of the tongue's attachments in front and at the sides. When one half of the tongue has been removed, the process is repeated on the other.

In a case in which the surgeon proposes to remove only half the tongue, the median section should be made before the attachments in front and on the diseased side are divided, as, of course, they need not be disturbed on the healthy side. The *écraseur* employed should be one curved 'on the flat,' and strong whipcord will be found more serviceable than the linked chain, which, from working only in one plane or nearly so, is much less readily looped far back.

In all cases in which, from the extent of the disease backward or in the floor of the mouth, any difficulty is anticipated in placing the loop of the *écraseur* well beyond the tumour, the cheek may be divided, with advantage, by an incision extending from the front border of the masseter to the angle of the mouth, as recommended by Gant and others.

Very commonly, at least when whipcord is employed, the main vessel and some other tissues, perhaps nerve-fibres, are pulled through the end of the *écraseur* after the softer substance of the tongue has been cut through. Under these circumstances, a double ligature should be passed with an aneurism needle, and the strand of vessels and nerves divided between the two knots, when the *écraseur* will, of course, at once come away, and the main vessels will be left on the face of the stump securely ligatured; or, if whipcord has been used, this may be cut through, and a single ligature applied to the small stump remaining.

After the removal of the tongue, wholly or in part, as the case may be, it should be carefully examined with reference to the question of how much healthy tissue has been removed with the cancer; and the floor of the mouth and stump of the tongue

should be carefully examined also, with the same object in view. In freeing the tongue from the floor of the mouth, portions of mucous membrane, sublingual glands, and the like, are often loosened; and these can be readily dissected away when space has been gained by removal of the tongue. Lymphatic glands should also be searched for, especially in the submaxillary fossa. Should any be found, now or previously, an incision should be made through the skin and other parts over them, and they should be carefully enucleated.

It is often advisable, especially when the disease has advanced into the mucous membrane of the floor of the mouth, to extract three or four of the neighbouring teeth from the lower jaw; and, when the disease approaches or invades the gum, much valuable space may be gained (much more than would be imagined by one who has not done it) by cutting away also a portion of the alveolar border of the lower jaw.

In cases in which the tongue is adherent to neighbouring parts, the clearing of the diseased from the healthy tissues is the most important part of the operation; and nothing helps so much towards this end as a free median division of the tongue. The difficulties are at least halved by this procedure. If the disease is found to have been not quite completely removed, any nodules left may be carefully dissected out either entire, or sufficiently to enable a strong silk ligature to be passed beyond them, as in the case of lymphatic cancerous nodules high up in an axilla.

Notwithstanding every precaution, troublesome and even profuse hæmorrhage may occur during an operation for removal of the tongue. If the hæmorrhage is of alarming extent, or at least sufficient to fill the mouth so rapidly with blood as to make it impossible to see whence the bleeding comes, it is an excellent plan to pass the forefinger into the mouth, as far back as possible, and hook forward the base of the tongue, as if to press it against the inner surface of the lower jaw, behind the symphysis. This plan (suggested by Mr. Christopher Heath) has been found by the writer very serviceable on more than one occasion, the hæmorrhage being at once controlled, and the surgeon gaining time for seizing with forceps the base of the tongue (if not otherwise held), and for bringing the parts forward so as to be able to see and catch the bleeding vessel. At the same time, the head should be rolled over to one side, so as to give opportunity for escape to the blood which may have accumulated

in the back of the mouth. Difficulties in seizing a bleeding lingual artery usually arise from momentary forgetfulness, on the part of the surgeon, that the part whence the hæmorrhage comes, unless firmly held and drawn forwards, will be retracted out of easy reach at every attempt to nip the bleeding point with forceps.

(2) *Whitehead's Operation.*—The operation for removal of the tongue suggested by Mr. Walter Whitehead is performed by dividing the muscular and other attachments of the organ by scissors. A gag having been introduced, and the tongue steadily drawn forwards and upwards by means of a thread passed through its substance, the operator snips the frenum and mucous membrane of the floor of the mouth, and subsequently the muscular attachments of the tongue, by means of scissors, until all the attachments excepting the glosso-epiglottidean folds of mucous membrane have been divided. The latter are then finally cut through, after passing a thread through the tissues immediately in front of the epiglottis, which is retained *in situ*, for a day or two, as a means of drawing the stump forward, if required on account of hæmorrhage or of falling back of the epiglottis over the upper opening of the larynx.

This is, the writer believes, a satisfactory operation in cases in which the disease is not far enough advanced to have caused adhesions to neighbouring parts, and in which the surgeon can depend on having a good light and a skilled assistant, and in which the jaws can be opened to a width sufficient for obtaining a clear view of the tissues as they are successively divided throughout the whole course of the operation. But in such cases the operation previously described can also be easily and rapidly performed. The choice, therefore, of the one method over the other will depend very much on the liking of the surgeon for the scissors or the *écraseur*. In many cases, a preliminary division of the tongue along the middle line will be found very serviceable when the scissors are used; and when one-half of the tongue has been removed by the *écraseur*, so much space will have been gained, and all the tissues are so clearly within view, that a few snips with the scissors are, in some cases, all that is required for the removal of the second half and the completion of the operation.

In the performance of Whitehead's operation the details, as laid down by him, should be carefully attended to; a neglect of them having much to do with the troubles, as to hæmorrhage, which have been some-

times met with. One of the most important of these is the steady traction of the tongue out of the mouth, which should be uninterrupted, and which not only brings each part well into view before division, but does much in restraining hæmorrhage.

In cases in which the tongue is adherent to neighbouring parts, so that it cannot be well drawn forwards, or in which the floor of the mouth is invaded by the disease; or in which a full view of the parts cannot be obtained, either from defective light or difficulty in opening the mouth, or restlessness of the patient from imperfect anæsthesia, the surgeon will do well to choose some other operation than cutting by scissors. Under the conditions referred to, an unfortunate snip of the lingual artery or one of its branches may lead to the filling of the mouth with blood, by which everything is obscured; while there may be inability to seize the bleeding vessel until the patient is faint from loss of blood, or has become half-suffocated by its entrance into the trachea.

There are no facts to warrant the conclusion that the wound left by the crushing action of the *écraseur* is less safe with regard to septicæmia than that left by the knife or scissors.

The plan of cutting down on the lingual artery (one or both) and applying a ligature to it, as a preliminary measure to removal of the tongue, is recommended by some surgeons. In most cases this is quite unnecessary.

Cases are sometimes met with in which the cancer has become closely adherent to the lower jaw, but in which the extent of the disease is not so great as to forbid an operation. In such instances a portion of the lower jaw may be removed; either a part of the alveolar border only, or a portion of the whole thickness of the horizontal ramus. Usually, in a case fit for operation, the anterior part of the jaw is the portion involved, and can be readily reached by making a vertical incision through the lower lip and down to the lower edge of the jaw, and then another cut at right angles to this (making with it either a \perp or L shape as may be required.) The flap or flaps are then dissected up from the bone, and the latter is deeply notched at two points with a saw, and the section completed with strong bone-forceps. The loose piece of bone, with the adherent mass of disease and more or less of the tongue, according to the extent of the cancer, is then removed. As all the parts are well within sight and reach, the knife, scissors, or *écraseur* may

be used, according to the fancy of the operator. The stump of the tongue should be firmly held during the division of the organ by means of a thread previously passed through it, so as to prevent it from falling back and interfering with respiration; the thread or a stout silver wire being afterwards fastened to the jaw or lower lip, and left in for a day or two.

(3) *Syme's Operation*.—This operation is performed by making a vertical median incision through the lower lip and chin down to the hyoid bone, and, after dissecting back the soft parts, dividing the lower jaw and separating the two halves, so as to expose the parts freely. The attachments of the tongue in front are then divided, and the organ removed by the knife. Unless the extent of the disease forbids it, the tongue should be divided along the middle line, as suggested by Buchanan of Glasgow, and only the diseased half removed. By these means one great source of danger after Syme's operation—the complete division of the muscles which attach the hyoid bone to the lower jaw—is avoided.

(4) *Regnoli's Operation*.—This operation is performed by making a semilunar incision immediately behind the horizontal ramus of the lower jaw, the horns of the incision extending nearly to the angles. An incision perpendicular to this is then made in the middle line from the centre of the first incision to the hyoid bone; and the two triangular flaps of integument thus outlined are dissected up, the surgeon taking care to avoid the facial arteries. The anterior bellies of the digastric muscles are now divided, and subsequently the attachments to the lower jaw of the genio-hyoids and genio-hyoglossi.

The mucous membrane of the floor of the mouth is now divided to an extent corresponding with the external wound; and, the tip of the tongue having been seized, the whole organ is drawn out through the incision and removed by dividing its attachments close to the hyoid bone.

This operation is now but seldom performed, as it possesses no advantage over the improved methods of removing the tongue through the open mouth, while it is a much more severe and troublesome proceeding.

(5) *Kocher's Operation*.—In this operation, as in Regnoli's, the tongue is removed through an infra-maxillary wound. An incision is made from a little above and behind the angle of the lower jaw, along the anterior border of the sterno-mastoid muscle to the level of the hyoid bone, then

forwards to the latter, and is continued along the anterior belly of the digastric muscle. The flap having been turned up, the surgeon proceeds to tie the lingual artery, and to remove the lymphatic glands and other structures which lie in the neighbourhood. The tongue is then removed. It is recommended by those who practise this operation that, as a preliminary measure, tracheotomy should be performed, and that during the operation the pharynx should be plugged by a large sponge. The operation is a severe one, and its performance can only be justified by the results (as to non-recurrence of the cancer) being proved much better than after the less dangerous methods of operating.

The tongue is now but rarely removed by means of the galvanic wire or other form of actual cautery, on account of the greater amount of sloughing and the greater liability to secondary hæmorrhage which are entailed by this procedure.

After-treatment.—Immediately after the operation iodoform should be applied to the raw surface of the wound and adjacent parts; and, as soon as the patient has sufficiently recovered from the anæsthetic, he should be warned to let all saliva and 'discharge' escape from the mouth, and to refrain from any attempts at swallowing. The mouth should be rinsed frequently with a weak lotion of permanganate of potash or of carbolic acid (about one part to a hundred of water.) Small pieces of ice should be placed occasionally in the mouth, especially if there is any tendency to bleeding. The application of iodoform should be repeated daily if the mouth become foul.

If slight hæmorrhage recur after the operation, it will be found, as a rule, easily controllable by ice or by syringing the mouth with ice-cold water; or a piece of dry lint or sponge may be applied to the bleeding surface, and held firmly there for a few minutes by the finger of a nurse or assistant. If the hæmorrhage occur from a vessel of notable size, it should be, of course, seized with forceps and ligatured; and, in order to effect this, the *first* thing to be done is to seize the stump of the tongue with strong forceps and draw it forwards, so as to bring the bleeding vessel within sight and reach.

In almost all cases the patient should be fed for a few days through a tube. A No. 10 or 12 red-rubber or black elastic catheter, fitted with five or six inches of thin elastic tubing sufficiently large to admit the end of a glass funnel, is all the

apparatus required. The catheter can be easily introduced through the open mouth and passed to a point about half-way down the oesophagus, when the fluid nourishment, thus untainted by the 'discharge' from the mouth, can be poured into the funnel in any quantity that may be necessary. In the same way a dose of castor oil or saline aperient may be administered on the day following the operation.

Nutrient enemata and suppositories may, of course, be administered, if there is any insuperable objection to the use of the tube.

W. MORRANT BAKER.

TONGUE-TIE. See TONGUE, Diseases of the.

TONSILS, Diseases of the.—The tonsils are composed of lymphoid tissue, covered on the buccal side by a mucous membrane continuous with that of the pillars of the fauces. Externally, they rest upon the superior constrictors, which separate them from the internal carotid and ascending pharyngeal arteries; and they are in close relationship, posteriorly and above, with the pharyngeal orifices of the Eustachian tubes. The internal carotid artery lies from one-half to four-fifths of an inch behind and to the outer side, and is hence in little danger of injury during the puncture or abscission of the gland.

The physiological variations of the tonsil in size and aspect are very considerable. It may encroach sensibly upon the isthmus of the fauces, or may be so shrunk as to have the appearance of a shallow sulcus between the two pillars; and the surface may be almost smooth, or deeply honey-combed with crypts, the orifices of which occasionally present small pellets of retained secretion.

The principal diseases of the tonsils are acute and chronic inflammations, syphilitic and tubercular lesions, and tumours of various kinds.

Acute inflammation may assume two forms—the erythematous or catarrhal, and the phlegmonous.

ERYTHEMATOUS TONSILLITIS is most common in early life, between the ages of five and twenty-five, and is especially prone to occur in rheumatic subjects. It is often epidemic, and may possibly be capable of spreading by infection.

The two chief causes are atmospheric contamination from bad drainage, and exposure to cold and damp. Erysipelas, measles, scarlet fever, syphilis, and belladonna-poisoning may also be associated with a symptomatic tonsillar erythema.

Symptoms.—The inflammation usually commences with a feeling of dryness and soreness of the mucous membrane of the tonsils and adjacent parts, associated with pain and a sense of stiffness of the parts on swallowing, and the expectoration of small quantities of viscid mucus. The affected gland is swollen, and at first red and dry in aspect, but may soon become covered with a thin pultaceous layer of epithelial debris, or studded with accumulations of pus in the glandular crypts ('follicular tonsillitis'), and the morbid condition may spread to the neighbouring parts. If the orifice of the Eustachian tube be reached, the complication is often indicated by a curious sense of irritation and tickling extending into the tympanum and external meatus, or, should the mischief go further, some dulness of hearing or even an active inflammation of the middle ear may supervene.

The constitutional symptoms bear no constant relation in degree to the local signs. More or less febrile disturbance is commonly present at the onset, and, where the affection is due to the inhalation of contaminated air, the nature of the evil may often be conjectured by the daily recurrence of profound mental depression, associated with a marked exacerbation of the local soreness and pain, on waking in the early morning; while food and pure air afford relief. Temporary albuminuria has been observed in some instances.

The disease, unless prolonged by the persistence of the cause, tends to subside in the course of the second week; but in unfavourable cases may pass into the phlegmonous form.

Treatment.—The occurrence of tonsillitis, especially in the follicular form, should always lead to a careful examination of the drainage of the house in which the patient resides, or of that in which he is occupied during hours of business. Should this be defective, the treatment of the symptoms will be of little service until the source of danger is removed.

Several remedies have been found useful as abortives at the onset of the disease. The chief of these are—(1) an emetic of ipecacuanha; (2) quinine in five-grain doses, repeated two or three times at intervals of a quarter of an hour; (3) salicylate of soda, in doses of fifteen grains, every three hours; (4) large and repeated doses of tincture of perchloride of iron (thirty to sixty minims); and (5) local application of bicarbonate of soda with the finger, or by insufflation five or six times in succession, at intervals of five minutes. If the affec-

tion pass on to the later stages, astringent gargles may be prescribed, the voice must be kept at rest, and the patient should be directed to breathe through the nose. Bland but nutritious food and pure air of equable temperature are important adjuncts to the medicinal and local measures.

PHLEGMONOUS TONSILLITIS (Quinsy).—The causes are those of the erythematous form, of which it is usually a sequel. In debilitated and overworked subjects it may develop under slight exciting causes.

Symptoms.—The condition begins as in the catarrhal affection, but the redness and swelling are more severe, and the inflammation usually becomes localised to a single gland. With the increase and diffusion of the inflammation are associated considerable pain and dysphagia, the respiration may be impeded, and the voice becomes changed. Tinnitus or partial deafness, spasmodic closure of the jaws, suffocative paroxysms, and enlargement of the submaxillary glands may appear as complications. There is tenderness on pressure externally opposite to the angle of the jaw, but any enlargement detected in this region is probably due to implication of the submaxillary lymphatic glands and not to the swelling of the tonsil itself.

Fever of variable degrees of intensity may accompany the local signs, and is generally associated with debility and mental depression.

When suppuration takes place the abscess may be single or multiple, and usually points inwards and forwards; but the pus may find its way towards the soft palate, or, in rare cases, may reach the suprahyoid region, or even show itself above the clavicle. The 'quinsy' of adults is commonly a suppurative inflammation of the areolar tissue of the soft palate or pharynx, rather than of the tonsil itself.

Treatment.—In the early stages, the treatment recommended for the erythematous affection may be sufficient. When abscess forms, the pus should be evacuated without delay by means of a bistoury guarded with a turn of strapping down to within half an inch of the point, and held with its cutting edge upwards and inwards (away from the internal carotid artery). Special instruments have been devised to add to the safety of the incision, but with ordinary care the armament of the pocket-case will be found quite sufficient.

The local application of cocaine may be of value as an alleviative in the acute stage of inflammation, and as an anæsthetic, before the incision of an abscess.

HYPERTROPHY OF THE TONSILS (Chronic Tonsillitis).—The pure hypertrophy of the tonsils depends upon an increase of the lymphatic elements; but this condition is almost invariably associated with intercurrent attacks of subacute and chronic inflammation, which may lead to dilatation of the vessels and some induration of the connective tissue of the gland. It is nearly always bilateral, although mostly unequal in development on the two sides.

It is most common in strumous and lymphatic subjects, and is almost confined to the earlier years of life.

Symptoms.—The tonsils, usually as a sequel of repeated catarrhal inflammation, become enlarged, and project more or less into the isthmus of the fauces, in some cases even coming into contact with each other. The surface in the quiescent state is of a pale rose tint, but during an inflammatory access may be red and congested, and is often dotted with whitish granulations about the size of millet-seeds. The submaxillary lymphatic glands may be secondarily enlarged. Pain is usually slight or absent, but deglutition is impaired, the voice becomes altered, and, where the hypertrophy is considerable, the respiration may become so gravely embarrassed that sleep is repeatedly broken by suffocative paroxysms, the blood becomes imperfectly aerated, and the general nutrition suffers. In association with this, the aspect of the patient; if a child, may undergo a characteristic and remarkable change: the chest becomes contracted, the mouth is kept open to allow freer ingress of air to the lungs, and the countenance assumes a vacant and fatuous expression—a peculiarity which is increased when, as frequently occurs, the hearing becomes impaired through extension of the inflammatory processes to the Eustachian tubes.

The condition is usually associated with a predisposition to coryza and bronchial catarrh. Its course is very chronic, and it may linger on from childhood to puberty or even into early adult life.

Treatment.—The constitutional measures should be adapted in great measure to the diathesis. As a rule, cod-liver oil, pancreatic emulsion, and ferruginous tonics are the most efficacious medicines; but pure air, suitable exercise, and well-regulated, well-selected food are of still greater importance.

Locally, the use of astringent gargles or the direct application of powdered alum may be essayed. Should this fail and the condition demand more active treatment,

the enlarged gland may be pierced with a point of galvano-cautery, or the redundancy may be excised.

The ablation of the tonsil may be effected by a stroke of the bistoury, by the use of special instruments, or with the finger-nail. The so-called 'Borelli's operation,' avulsion by means of the finger-nail, is now practically abandoned, as liable to prove more painful and dangerous than any other method of removal. The use of the knife is still advocated by many surgeons. The most eligible instrument of the kind is a blunt-pointed bistoury, guarded by a turn of lint or strapping to within about three-quarters of an inch of the extremity; the cutting edge must be turned upwards and inwards, and manipulated while the gland is held with a pair of vulsellum-forceps. The guillotine, however, affords the safest and the most ready means of effecting the object. Many forms of this instrument have been devised, all answering the purpose more or less satisfactorily, but one of the best is that manufactured by Collin, which is provided with a kind of fork for transfixing and drawing inwards the gland at the moment of section. The operation is most easily effected when the surgeon stands behind the patient, whose head is to be well thrown back, but it may be performed with little less facility from the front.

The only danger to be feared in connexion with tonsillotomy is that of hæmorrhage. As a rule the loss of blood is very trifling in amount, but occasionally it is copious, and in one or two instances has even proved fatal. It may follow immediately upon the operation or occur after an interval of some hours, and is probably due to the implication of supplying vessels, that have become enlarged as a result of chronic hyperæmia of the gland; at any rate the flow is very rarely derived from the internal carotid artery, which can scarcely be wounded by any possibility with the guillotine, and only in the event of culpable neglect when the knife is employed. If severe, the bleeding may be arrested most conveniently by direct compression with a piece of lint, that has been soaked in a solution of perchloride of iron and wrapped around the handle of a spoon. The atrophy of the testicles, formerly supposed to be a possible consequence of the removal of the tonsils, is a contingency that need scarcely be taken into consideration. In the rare cases where such a condition has been observed after the operation, it has more probably been attributable

to impaired nutrition induced by the disease, before the treatment was carried into effect. Excessive mental depression, which has been known to culminate in suicide, appears, however, to be a real danger, but is one for which it is not easy to find an explanation, unless we infer with Dr. Rubio the existence of a pharyngeal reflex, analogous in its nature and results to the well-known anal reflex.

ULCERATION of the tonsils may be syphilitic, tubercular, or epitheliomatous in origin, or may develop symptomatically in the course of scarlet fever, diphtheria, &c.

TONSILLAR CALCULUS consists of a concretion of phosphate and carbonate of lime, very similar in character to the tartar upon the teeth, and is found in the normal crypts of the gland. It may reach the size of a pea or small bean.

TUBERCULAR LESIONS.—Tuberculosis of the tonsil may appear in two forms, as (1) miliary granulations, which may follow an acute or chronic course; or as (2) an irregular ulcer of no great depth, characterised by the absence of induration, and the presence of tubercular matter in the borders and base of the sore. As a rule, neither condition is limited to the gland.

SYPHILITIC LESIONS.—A few cases of hard chancre of the tonsil have been reported in recent years, but the complaint is very rare; secondary and tertiary lesions, however, in the form of mucous tubercles and gummatous ulcers, are amongst the most frequent manifestations of the disease. See *Syphilitic Stomatitis*, under STOMATITIS; SYPHILIS.

TUMOURS.—*Hydatid cysts*, *fibromata*, and *myeloid* tumours have been met with in exceptional cases. *Sarcoma* is less uncommon, and generally takes the form of lympho-sarcoma. In nine cases collected by Mr. Butlin, the ages of the patients ranged between seventeen and fifty-three. In all, the disease had extended to the cervical glands, but only to those in immediate proximity to the growth; and in three instances in which post-mortem examinations were performed, a secondary affection of the viscera was demonstrated. Two new cases were added to the list by Mr. Clutton and Mr. Balding in 1884.

The removal of the growth by excision is a formidable operation, but has been undertaken with success. Out of seven published examples, death from hæmorrhage and exhaustion followed in one, cure is claimed in two, and in the rest a recurrence followed within a few months. The disease may sometimes be accessible from

the mouth with or without the division of the cheek, but in other cases it is necessary to expose the parts more fully by section of the inferior maxilla.

Epithelioma of the tonsil is seldom primary, but extends to the gland from adjacent parts. It may be scraped and cauterized with temporary advantage, and bold and extensive operations for removal of the disease by excision have recently been accomplished with success by Pollaillon, Golding-Bird, and others.

The most frequent primary cancer of the part is *encephaloid*, while *scirrhous* is extremely rare. These affections have hitherto escaped the knife, but if seen at a sufficiently early stage might be treated in the same manner as sarcoma.

WILLIAM ANDERSON.

TOOTHACHE may be due to irritation of the tooth-pulp itself or to inflammatory conditions external to the tooth, though in immediate contiguity with it. It is important to discriminate between the two sets of causes, for the means for relief differ widely. Pain arising from a living pulp varies much in character; often it is very intermittent, coming on in darts, especially at the outset, and, even when continuous, it is subject to paroxysms of greater intensity. When severe, it is generally of throbbing character, and the tooth is very sensitive to changes of temperature; cold, however, occasionally is a relief, heat almost invariably an aggravation of the pain. There will be little tenderness on tapping the tooth, and none on pressing the gum over its roots.

Sometimes, the pain is of a neuralgic type and not felt in the offending tooth, so that its cause can only be discovered by careful examination of the teeth. It is aggravated by fatigue, relieved by tonics, stimulants, food, &c.

Hence, in any case of doubt, the teeth should be successively tested by the application, first, of a hot instrument, then of a large piece of wool dipped in cold water. If no sensation of pain results from these abrupt alternations of temperature, it is possible that the nerve is dead or dying, so that evidence of inflammation in the sockets should be sought by first smartly tapping the teeth in succession with the handle of an instrument of some weight, then pressing them home into their sockets, and, lastly, making firm pressure over the roots of each tooth. By such an examination, it will generally be possible to discover whether a tooth be the cause of pain or not, and to form an idea of its state if it be so.

If the pain be due to inflammation surrounding the tooth, the nerve will usually, though not quite invariably, be dead; there will be much tenderness elicited by tapping, or by pressure over the roots, and none by the test of heat and cold; if it has lasted long there will be swelling of the gums and more or less febrile disturbance. See GUM-BOIL. The cavity of decay should be cleared out, or, if it have been filled, the filling should be removed, so as to give free access to the pulp-cavity, and a little creasote, camphorated spirit, or oil of cloves is to be pumped down the roots; but the tooth must then be left perfectly open, so that pus or exudation can easily drain away. In the early stages, the gums over the roots should be painted with equal parts of tinctures of iodine and aconite; in the later stages deeply lanced.

If, on the other hand, we have to deal with a living pulp, and the pain have been of short duration and not very severe, the tooth should be closed up with a dressing of oil of cloves, creasote, or carbolic acid, confined by a pledget of wool dipped in a solution of gum mastic or sandrach. If the pain have been very severe, it is probable that there is a tiny drop of pus in the pulp-chamber pressing on the remains of the pulp; the pulp-chamber must then be carefully opened up and a dressing of the same nature applied, but, though this will give relief, the pulp is sure to die, and the best thing is to at once destroy it by an application of arsenious acid. This, however, should only be applied by those well accustomed to the manipulation of teeth, as disastrous results in the way of sloughing of the gum, necrosis of the neighbouring alveolus, &c., may follow upon the escape of any arsenic from the cavity. For the relief of pain a dead tooth should be left quite open, a live tooth carefully closed up.

Other less frequent causes of toothache are irregular calcifications of the pulp, exostosis of the roots, and the inflammation which attends the loosening of the teeth in old age; in a modified form this is, however, often met with in middle life, and when it occurs thus prematurely, it runs a more acute course, with more pain, suppuration, and ill smell, but, on the other hand, is more amenable to treatment. Another cause of obscure toothache is difficult eruption of teeth, especially of the wisdom teeth, which may ultimately be attended with violent inflammation of the superincumbent gum and surrounding parts. In many cases there is an absolute want of space, and no permanent relief will be got

without the extraction of the wisdom tooth, or, if this be impossible, of the tooth in front of it. In the vast majority of cases it is easy to discover the cause of pain due to morbid conditions of the teeth; but it occasionally is very difficult, especially when there are many teeth the condition of which is such that they are possible, though not probable, causes. It must not be forgotten that the gum will sometimes heal completely over a diseased root, or so nearly completely that only very careful search will discover any fistula.

Old-standing inflammations may also sometimes have involved the nerve-trunk, and so leave a legacy of pain even after their removal; this seems most prone to happen with lower wisdom teeth, the apices of whose roots are so very close to the inferior dental canal. CHARLES TOMES.

TOOTH-TUMOUR. *See* ODONTOMA.

TORSION.—This method of arresting hæmorrhage from large or small vessels was introduced by Amussat in 1829, and in this country was prominently brought forward by Mr. Bryant in 1868. To its originator it was suggested by the fact that 'torn vessels do not bleed.'

Numerous experiments upon living animals, upon dead arteries, and its practice in amputations in man, show that the effect of torsion is to rupture the internal and middle coats, as in ligation. The coats, moreover, are incurved, and being stripped from the external, are turned into the lumen of the vessel, so that the broken edges look towards the heart. Coagulation taking place around and—when the incurvation has been less complete—between the ruptured coats, prevents at once the escape of blood. The inflammatory process uniting the edges and the subsequent changes in the clot are the same as in ligation.

There are two ways of employing torsion: the 'free' and the 'limited.' In the 'free' the vessel is held by the forceps a short distance from the end, either parallel with or transverse to its axis, and twisted round and round. The objection raised to this plan, that the vessel is rotated through a great portion of its length and not completely twisted at any point, has no foundation, for it has been abundantly shown that only that part of the artery immediately above the forceps is twisted, and effectually so. This is the method now usually adopted. In the 'limited,' the vessel is first drawn out of its sheath and fixed by forceps three-fourths of an inch from the divided end,

while with a second pair the extremity is seized and freely twisted. Special forceps must be used. They have flat, parallel, finely serrated blades secured by a sliding catch.

Torsion of large vessels—e.g. the femoral—is best performed in the following way. The artery is taken up by a pair of dissecting forceps and drawn forwards, the surrounding tissues being pushed back by a second pair till sufficient room is made for the application of torsion-forceps across the vessel, about one-eighth of an inch from the divided end. The whole width of the vessel must be grasped. The forceps are now rotated (or swung round) at right angles to the axis of the vessel, six complete revolutions being sufficient for the femoral, and four for smaller vessels. It is the practice of some surgeons to take up the vessel longitudinally, and rotate the forceps round in the hand; but this does not seem to secure such effectual torsion as the plan described above, for the whole width of the vessel is not included in the grasp of the forceps. When the torsion has been effective and complete, a loss of resistance will be felt, owing to the rupture of the inner coats, and whether one turn more or less secures this result is a matter of indifference.

It is well to allow the forceps to remain attached for a few minutes while the coagulum is forming, the other vessels being secured meantime. On removing the forceps, the twisted end uncoils a few turns and retracts into the sheath and the surrounding tissues, by which it should be well covered. The writer has in this way secured the first part of the axillary, and on several occasions the femoral. As to its safety, it is only necessary to quote Mr. Bryant, who gives 200 consecutive amputations at Guy's Hospital, in all of which the main artery was twisted, without a single case of secondary hæmorrhage.

In closing smaller vessels, it is only necessary to simply seize the end and give it several rapid twists.

Torsion is chiefly of value in securing the large vessels, and, when successful immediately after its application, there is no fear of secondary hæmorrhage unless unhealthy suppuration exist in the wound. It is the practice of the writer and of several other surgeons to secure the main vessels by torsion and the smaller by catgut.

CHARTERS JAMES SYMONDS.

TORTICOLLIS (Wry-Neck).—Deviation of the neck from the right direction is caused primarily by contraction of the

sterno-mastoid muscle, in most instances; other muscles may be associated with the sterno-mastoid, particularly the trapezius, the splenius, and the scaleni. The levator anguli also helps in approximating the head and shoulder.

The back of the head is drawn down towards the shoulder of the affected side, the face and chin being directed towards the opposite shoulder. The affected side of the neck is concave, and a very definite hollow may be made out below the mastoid process; across it is stretched the tight band of the sterno-mastoid. The tissues of the affected side of the face are, in a marked case, imperfectly developed, even to the inferior maxilla itself; the mouth and eyelids are drawn down, and the expression is changed and characteristic. On examining the lower half of the sterno-mastoid, the sternal and clavicular pieces may be found rigidly contracted and distinct.

The cause of the contraction of the muscle may be found—(1) in the muscle itself; (2) it may be due to the irritation of cervical caries, to an inflammatory attack of the vertebræ, periosteum, ligaments, muscles, nerves, or connective tissue of the neck, or to the presence of an inflamed or suppurating gland. In these cases, the contraction of the sterno-mastoid will be as a reflex act through the spinal-accessory or the second cervical nerve. Or, the contraction may be due to (3) some central irritation in the brain or spinal cord.

(1) When the cause of the contraction is in the muscle itself, it is generally the result of a tearing of bundles of its fibres during parturition, in which case a hard and tender ovoid lump may have been noticed in the course of the muscle or of one of its heads of origin within a few days or weeks of birth. The lump may be of the size and shape of a filbert or small walnut.

At one time it was thought that these sterno-mastoid tumours were of syphilitic origin, but any association they may have with such congenital taint is but accidental; the condition is due to a partial rupture of the muscle during parturition. Often the tumour is found after a difficult labour, but the writer has met with a case of such tumour, in which parturition had been so rapid and easy that neither midwife nor doctor had assisted. The tumour consists of torn muscle, blood, and inflammatory effusion. The mass becomes smaller by absorption, but the cicatricial patch in the muscle undergoes a steady contraction, until the ear may almost touch the shoulder. In the fat, short-necked infant, both the

tumour and the early deformity of the neck may pass unnoticed; but as the neck grows the deviation becomes conspicuous, as may also be the arrested growth of the corresponding side of the face. The writer has recently been treating a young man, in whose case all the links in the clinical report were complete. The mother said that his had been a 'cross-birth;' that when he was a week or two old a 'lump' was noticed in the course of the muscle; the torticollis was complete.

(2) When the deformity is due to cervical caries, it is generally associated with obscure pains which radiate about the shoulders, neck, or scalp, according to the distribution of the sensory nerves whose trunks emerge at the carious region, and thus are compressed by inflammatory products. In the early stages the disease is apt to elude correct diagnosis, the 'stiffness of the neck' and other equivocal symptoms being frequently ascribed, at least by parents, to 'rheumatism.' If the patient be young or unintelligent, the neuralgic pains in the occipital and parietal regions may be spoken of as 'headache.' Stiffness of the neck is an important symptom; the patient cannot turn the head without at the same time wheeling round his shoulders and trunk, nor can he nod or shake the head freely. Pressure on the top of the head causes distress. *See CARIES OF THE SPINE.* It is of the utmost importance that an early diagnosis be made, the treatment demanding extreme gentleness, firmness, and a long-continued patient supervision. The writer has seen wry-neck suddenly caused by an acute attack of otitis and periostitis of the cervical vertebræ, the result of a severe wetting of the head and neck of a child. The head was drawn down towards the right shoulder, and thus steadied against disturbance. Pressure upon the spinous processes or upon the top of the head gave intense pain. Such a case demands leeches, fomentations, and absolute rest in bed, the head being steadied between sand-pillows.

Wry-neck, due to the reflex contraction of muscles from peripheral irritation of inflamed tissue of the neck or glandular abscess, will disappear on the subsidence of the primary trouble, though exercises such as those sketched below may prove of advantage. For the deviation of the neck in infancy, gentle frictions and frequent adjustments of the head, as a precautionary measure, should be undertaken. But when such measures prove inefficient, as they most likely would in the case of the growing child, or the adult, or in the wry-neck

caused by vertebral caries long since passed away, tenotomy, under an anæsthetic, may be required. For this purpose a slender, blunt-pointed blade should be passed cautiously beneath that part of the muscle which shows most prominently at the root of the neck, when the head is brought towards the straight line. The puncture of the skin is made about half an inch above the clavicle with a sharp-pointed tenotome: and then with the blunt knife every resisting band must be severed. The skin-puncture is covered with a small compress of dry lint and a bandage, the head being left in the old position until the wound is sound. After section of one head of origin of the muscle, the other may be found in need of division; in this case two separate punctures of the skin are desirable. A few days after the tenotomy, frictions and shampooings of the neck should be begun, and the patient should be drilled in exercises to raise the head and depress the shoulder. He should carry a weight in the hand, and at the same time incline the head away, so as to stretch to the utmost the concave side of the neck. This stretching should be kept up at night by his lying with the affected side of the face upon a firm pillow. With this treatment, combined with massage, no mechanical apparatus need be required for the straightening of the neck, even in the adult. The operation is not entirely devoid of risk; troublesome bleeding may occur from the accidental and unavoidable wound of a blood-vessel, and should a venous tributary be stretched across the course of the knife, air may enter the circulation. In either case a firm compress should be adjusted. After the division of the contracted muscle, various secondary bands of shortened fibrous tissue will assert themselves; these will rarely need division with a knife, they will yield to drilling and manipulation.

(3) When the deformity is due to some central nervous irritation, the treatment is often unsatisfactory. The spasmodic contraction may be jerking, irregular and convulsive, and never cease during the waking of the patient. It is most common in young adults 'whose families have seemed prone to other cerebro-spinal affections' (Little). The treatment will comprise the administration of bromide of potassium and tonics; the employment of the mind; and the use of galvanism and massage. Tenotomy would afford but temporary relief, and even the stretching of the spinal accessory nerve, or the resection of a piece of it, does not always end the trouble. The nerve

may be found either on its entrance to or emergence from the sterno-mastoid. In the former case an incision is made along the anterior border of the muscle, starting from the mastoid process, and descending for about two inches. The external jugular vein would have to be drawn forwards; and the head being still further inclined towards the shoulder of the affected side, in order to slacken the sterno-mastoid, the anterior border of the muscle would be slightly raised and everted, and the nerve running obliquely into its substance would be recognised. About half an inch of it should be taken away.

Neuro-mimetic contraction of the sterno-mastoid is most likely to be met with in girls; its onset may be sudden, and the symptoms over-acted.

Wry-neck from the contraction of an extensive cicatrix (as after a severe burn) is best dealt with by massage and exercises.

EDMUND OWEN.

TOURNIQUETS are instruments which are employed to arrest or diminish the flow of blood along the arteries to the limbs. There are two classes of tourniquets; the principle of one of them is to constrict the whole limb and to arrest the circulation through the collateral vessels as well as through the main vessel of a limb, whilst that of the other is the accurate limitation of the pressure to the main vessel, so that the flow of blood through it alone may be slowed or arrested.

Those of the first kind are used to prevent bleeding during the performance of operations on the limbs, or as a temporary means of checking bleeding from wounds of the limbs. For the latter purpose, in cases of emergency, the original plan, invented by Morel, may be employed; it is to tie a cord or a piece of bandage round the limb and pass a stick beneath the cord, and then to turn it round and round until the cord is twisted up and tightened sufficiently to arrest the circulation.

The elastic tourniquets of the present day act in a similar manner.

Esmarch's tourniquet is a strong elastic cord or tube, the bore of which is very small; a hook is attached to one end of it and a chain to the other. In using this, and all tourniquets which constrict the entire limb, the limb should be bandaged or raised, in order to favour the return of the venous blood, and then the cord should be rapidly stretched and wound round the limb, the two ends going in opposite directions and being finally secured by fastening

the hook to one of the rings. If applied slowly, the veins would be first compressed, and the limb consequently would become congested. Sometimes the ends of Es-march's tourniquets do not meet just as required, and so they have to be carried once more round the limb, upon which they exert an undue constriction. See ESMARCH'S BLOODLESS METHOD.

Various modifications of this instrument have been introduced, with the object of remedying the defect alluded to above and of facilitating the removal of the tourniquet. Foulis' catch is one of these. It consists of a piece of vulcanite, about an inch and a quarter long, three-quarters of an inch broad, and half an inch deep; it is perforated along its longest axis by two holes, having a diameter of about an eighth of an inch; one of these communicates with the surface of the pad along its whole length by means of a slit; the elastic cord is threaded through the other hole. The pad is placed over the vessel, and the limb is encircled with the cord once or twice, and finally both ends, still on the stretch, are forced into the slit in the pad; when the ends of the cord are relaxed, the increased thickness which results serves to secure them firmly in the catch. Davy has recently introduced a catch which acts like the one just described, but it can be secured more firmly in position; its long axis is placed in the line of the vessel, and the elastic cord, which runs in the opposite direction, keeps it steady. Ward Cousins has substituted a buckle for the catch. His tourniquet consists of an elastic cord folded upon itself so as to form a loop, the ends of which are attached to the buckle. In place of the teeth of the common buckle, the one used has a plate with a serrated edge, which is not sharp enough to bite into the india-rubber, but is rough enough to get a good grip on to it. To apply the tourniquet, the cord should be stretched tightly round the limb, and should be secured by drawing the loop through the buckle.

All the tourniquets composed of an elastic cord are open to the objection that the cord produces severe constriction of the limb; this may be obviated by employing a stout elastic band with a piece of tape attached to each end, or with a buckle like that above described fixed to it about a foot and a half from one end; when applied, it may be secured by tying the tapes together into a bow, or by drawing the end of the india-rubber band through the buckle.

A field-tourniquet constricts the entire limb. It consists of a metal plate, to which a small pad is attached, and of a piece of

stout tape. The plate has a slit at each side, through which the tape can be passed, and each lateral border of it has three teeth projecting from it. To apply the tourniquet, the tape should be placed beneath the limb, and each end of it should be passed through one of the slits in the plate above mentioned. By pulling on the ends of the tape the pad is pressed against the vessel, and the pressure can be kept up by fixing the ends of the tape into the projecting teeth on each side of the plate.

Petit's tourniquet may be employed either to constrict the entire limb, or, if a pad be placed over the main artery, to compress the latter and, at the same time, exert some general compression. The instrument consists of two plates, which can be separated from one another by means of a screw; a piece of stout tape is threaded into the plates in such a way that separation of the plates will draw on the ends of the tape. To apply the tourniquet, the plates should be placed in contact, and the tape should be buckled round the limb tightly enough to hold the instrument in position. By turning the screw, the plates may be separated, and the limb and main vessel compressed. *Petit's* and field-tourniquets are useful instruments to keep loosely applied to a limb from which hæmorrhage is anticipated, as either of them may be readily tightened up by a nurse.

The second class of tourniquets—viz. those which are intended to compress the main vessel of the limb alone, are chiefly used in the treatment of aneurisms. They are as follows:—

Signoroni's horse-shoe tourniquet is intended chiefly for the brachial artery. It consists of two stout steel arms, carrying pads at their extremities, which can be approximated or removed from one another by turning an endless screw placed at the hinge of the instrument.

Lister's (known also as *Pancoast's*) tourniquet is intended for compressing the aorta or common iliac in the treatment of aneurism of these vessels, or during amputation at the hip-joint. It consists of a large horseshoe-shaped piece of iron, carrying a pad at one end and perforated at the other by a female screw, through which a rod carrying a pad, and provided with a male screw, is introduced. The pad is screwed down on to the aorta at its bifurcation, which takes place at the level of the highest point of the crest of the ilium; the pad is so fixed on to the rod, which bears it, that the latter can be turned round without causing the pad to revolve; and when

screwing the pad firmly home, it should be held on the vessel with the left hand whilst the screw is being turned by the right.

Skey's tourniquet is intended for compressing the common iliac or the brachial arteries. The whole instrument has an elliptical outline, and completely encircles the limb to which it is applied. It consists of two plates, which are connected together by quarter-circle steel bars, themselves composed of two pieces sliding one on the other, so that the size of the instrument can be reduced to the circumference of the limb to which it is applied. One of the plates above mentioned forms a pad, which should be placed behind the limb; in the other plate, a steel rod, having a pad, works in a similar manner to that described in *Lister's* tourniquet.

In the instruments above described, the pressure of the pad on to the vessel is maintained by the rigid force of a screw, and is accordingly most irksome if it be kept up for a long time, as is the case in the treatment of aneurisms. With the object of remedying this, *Carte* has, by a most ingenious contrivance, converted the rigid pressure of the screw into an elastic one; and so great is this improvement, that in the treatment of popliteal aneurisms by instrumental compression of the common and superficial femoral vessels, *Carte's* instrument should be used in preference to those already described.

Carte's compressors are adapted for compressing the common femoral artery in the groin and the superficial femoral at the apex of *Scarpa's* triangle. They possess two great advantages—(1) that the rod which carries the pad is fixed to the rest of the instrument by a ball-and-socket joint, which renders the pad less liable to shift from the artery during any slight movement of the patient; (2) that the pressure exerted by the instrument is an elastic one. In the old-fashioned compressors, the rod which carries the pad moves in the framework of the instrument by means of a screw. In *Carte's* compressor it moves up and down without a screw, but just above the supporting framework there are two plates; the lower of these is fixed to the framework, and, like the latter, allows the rod which bears the pad to move freely through it; the upper one only permits the rod to move through it by being screwed round. The two plates are joined together by a strong piece of elastic on each side. When the attempt is made to screw the pad down, the first effect is to separate the plates and put the elastic on the stretch;

and it is only when the elastic is well stretched that the pad is pressed on to the vessel. If the pad be too tightly screwed down the elastic will be still more stretched, and so the pad will be allowed to rise a little from the limb and undue pressure will be relieved. *Carte's* larger instrument—viz. that for the groin—is fixed on to the pelvis by a broad and well-padded belt. The smaller instrument is very like *Skey's* tourniquet in shape, but its size cannot be altered as that one can.

Tuffnell's compressor consists of a truss-spring, with a pad which presses on the artery. It is fixed in position with straps, which also serve to press the pad more firmly on to the vessel. It is used for compressing the femoral artery.

Higginbottom's alveolar tourniquet is composed of two blades, with a pad at the end of each; its principle of action is like that of *Signoroni's* tourniquet. It is used to make pressure on bleeding tooth-sockets; this is accomplished by one of the blades within the mouth, whilst the other blade presses against the inferior border of the body of the lower jaw. A similar instrument is made for the upper jaw; one of its blades makes a wide sweep so as to fit on to the top of the head.

Weight-compressors are of two kinds. One consists of a conical bag with a truncated apex. The bag should be filled with shot and suspended over the vessel to be compressed, and steadied in position by the patient. The other (*Watson's*) consists of a weight, which is suspended from a *Carte's* elastic spring, and so adjusted that it rests upon the vessel. BILTON POLLARD.

TRACHEAL CATHETERISM.—The introduction of instruments through the mouth into the trachea was first attempted by *Desault*, who saw the immunity from evil following the accidental introduction of an œsophageal tube into the trachea, the tolerance with which the patient bore it, and the easy manner in which he respired through it. This took place toward the close of *Desault's* life, and he had few opportunities of practising the method. Efforts in the same direction were subsequently made by other surgeons, among whom was *Bouchut*, who practised what he termed *le tubage du larynx*, but who was so unfortunate as to be unable to record any case in which the life of the patient was saved by this method. *Trendelenburg* and *Schröter* pass three-cornered vulcanite tubes into the larynx, in chronic cases, for purposes of dilatation. Since 1878 the writer has had

the opportunity of introducing tubes into the trachea through the mouth in a variety of cases, and the practice has been attended with favourable results.

It need scarcely be premised that, when it is practicable, a laryngoscopic examination ought to be made previous to passing the tracheal catheter. Some prefer to introduce the catheter by aid of the laryngoscopic mirror, while others are satisfied to be guided by the sensation of touch and an accurate anatomical knowledge of the parts. The catheters may be passed either with or without the aid of anæsthetics. Local anæsthesia, such as may be induced by the repeated painting of morphia solution on the outside of the larynx, or by the application of a solution of cocaine to the mucous membrane of the larynx, is of benefit in diminishing the sensitiveness of the parts, and preventing the troublesome expiratory efforts immediately following their introduction. Under chloroform, the introduction is attended by very little coughing, and a fresh whiff of the drug, inhaled through the tube, speedily allays any irritation which may have been set up. In a number of instances, the tubes have been passed by the writer without the aid of either local or general anæsthesia; both in cases where the larynx and trachea were in a normal physiological condition, the tubes having been passed in such instances in order to prevent blood from entering the trachea during operations about the mouth, and also in acute and chronic diseased conditions. In the former class of cases, when the patients were adults or were old enough to understand intelligently, the method of introducing the tube, and the sensations which its introduction gave rise to were explained to them, and they were invited to aid its introduction—first, by endeavouring to control coughing or retching; secondly, by being prepared to take a long inspiration at the moment of inserting the tube into the larynx; and thirdly, after the introduction of the tube, instead of persisting in violent expiratory efforts, to allow a deep inspiration to take place.

When the tube is about to be inserted, the patient's head is thrown well back, his mouth is opened, and if he be nervous a gag is introduced; in children this precaution is always taken. The tongue is then well drawn forward. The operator's left index-finger is introduced until it touches the epiglottis, which it depresses against the tongue. If the laryngoscopic mirror be used the epiglottis may be left free. The tracheal tube is made to pass over the

index-finger, until it is engaged in the glottis, the patient being then instructed to take a long deep inspiration, and at the same moment the tube glides between the cords into the trachea. If the tube be made of hard rubber, the operation is now completed; if it consists of soft gum-elastic, the stylet used in introducing it is removed. The patient then gives vent to a series of prolonged expiratory efforts, which are generally greatly lessened after his first full inspiration. During the five minutes subsequent to its introduction, the cough may be very troublesome, but at the end of that period a tolerance has generally been established. A few inhalations of chloroform through the tube, at this stage, greatly mitigate the irritation.

There are considerable individual differences in the degree of toleration of the tube. In some diseased laryngeal conditions, the parts are by no means so sensitive as they are in health, and when once the tube is introduced, they are much more tolerant of its presence. The fact that the obstruction to the breathing has been overcome, gives the patient a sense of relief which causes him to regard the tube favourably. In one such case the patient was suffering from an advanced epitheliomatous affection of the larynx, and was in great distress from dyspnoea at the time he was first seen by the writer. After examining with the laryngoscope, a small-sized tracheal catheter was introduced while he stood in the theatre, its insertion being attended by very little coughing, and a few minutes afterwards he walked to his ward, steadying with his hand the extremity of the tube which projected from his mouth. It afforded him complete temporary relief, and enabled him to have a sound sleep, the first he had had for many days. In children the parts are soft and much more easily injured, and therefore the introduction of the tube must be undertaken with greater gentleness. There is also the difficulty to contend with, in the want of understanding on the part of the child; therefore the head requires to be held, and the gag to be introduced. A nurse is required to attend to the child afterwards, to prevent the tube from being removed.

In most cases it is better at first to insert a catheter of less calibre than the capacity of the larynx, as it will be admitted more readily, and subsequently a larger one may be inserted. In cases of dyspnoea, due to exudation about the glottis, the patient is able to breathe with freedom if the catheter be withdrawn at the end of

a few hours. The œdema is apt to return, however, and therefore it is better to retain the instrument in the trachea for ten or twelve hours. It may be withdrawn at the end of that period, and again inserted if the patient has any further respiratory difficulty. Not only can respiration be carried on through the catheter, but the patient has the power of expelling mucus or other secretion from the trachea beyond the distal extremity of the tube. He can swallow while the tube is in the larynx without any of the liquid gaining access to the trachea. When vomiting occurs, the ejected matters do not pass into the air-passages.

The catheter may be known to be in the respiratory passages from the sensation imparted by the tube passing over the first ring or two of the trachea; by the fact that there is a current of air flowing into the tube on inspiration and one passing out on expiration—the opposite being the case if it be in the œsophagus. A lighted taper or match will demonstrate these currents.

When the catheter is to be inserted to prevent blood from gaining access to the trachea during operations about the mouth or fauces, it should be mounted with a double fold of india-rubber tubing which fits firmly on the tube, and at the same time it should be sufficient to occlude the laryngeal orifice. This india-rubber ring may be about half an inch in length, and be placed about three inches from the proximal extremity of the tube. When this tube thus furnished is inserted into the trachea, the anæsthetic may be administered through it, the currents of air being distinctly audible to the chloroformist, who thus has a ready guide to the state of the respiration. The anæsthetic may be continuously administered during the whole time, without interfering with or stopping the operation. It answers the same purposes as Trendelenburg's tampon-canula, with the advantage of not complicating the major operation with tracheotomy or its after-results.

Tracheal catheters may be introduced in cases where the respiration is impeded by other than movable bodies, which might be pushed before the instruments further into the trachea. In cases of œdema glottidis and laryngeal stenosis, the presence of the catheter in the trachea for a few hours often gives great relief. If care be taken, the cords are not injured, the voice afterwards becoming quite restored. In cases of acute and severe laryngitis, tracheotomy is the better procedure. The introduction of the tube requires practice on the cadaver;

when this can be accomplished on the dead body, it will be found easy to introduce it afterwards on the living.

WILLIAM MACEWEN.

TRACHELORRHAPHY. *See* EMMET'S OPERATION.

TRACHEOTOMY. — This operation may be defined as the artificial opening of the trachea, either to give entrance to air, or exit to foreign bodies; or for the purpose of gaining direct access to the windpipe for the removal of morbid growths. The operation is indicated in all cases where the free entrance of air to the lungs is interfered with, by a mechanical hindrance situated in the larynx or trachea.

Tracheotomy is now almost always preferred to LARYNGOTOMY in cases where the impediment is likely to persist for any length of time. Thus, tracheotomy may be required in laryngeal diphtheria; in cancer and malignant disease of the larynx, both primary and secondary; in certain diseases affecting neighbouring parts, and causing pressure on or displacement of the trachea, such as goitre, aneurism, or disease of the spine; for foreign bodies in the trachea or bronchi; and in some cases of laryngeal ulceration (for the purpose of giving rest to the cords), &c. In short, in all cases where life is threatened by a mechanical hindrance to respiration, which itself cannot be otherwise removed sufficiently rapidly, this operation is indicated. A consideration of the foregoing indications cannot fail to show that the operation must not, in any sense, be considered as a curative or therapeutic measure; it is but a means to an end, and the treatment, which may be appropriate to the various conditions calling for the operation, ought in no way to be suspended or interfered with after the operation has been performed.

THE OPERATION.—*Seat of Incision.*—When the opening in the trachea is made above the level of the thyroid isthmus, the 'high operation' is spoken of; when the opening is below the isthmus, it is spoken of as the 'low operation.' For anatomical reasons, to be presently alluded to, the high operation should always be selected unless some contra-indication exists, especially in the case of children and short-necked persons. Many operations which are called tracheotomies would be more accurately described as crico-tracheotomies, for the reason that the cricoid cartilage participates in the incision.

Anatomy.—The trachea, owing to the large amount of soft cellular tissue by which

it is surrounded, is very movable. It is grasped between the lobes of the thyroid gland, and the isthmus which connects these lobes crosses its upper part, the whole gland being bound down upon the trachea by the deep layer of the cervical fascia. The isthmus of the gland (which is chiefly concerned in tracheotomy) varies much in size, being usually larger in females, and sometimes assuming very considerable proportions. In front of it is a large plexus of veins, which in all forms of pulmonary obstruction becomes gorged, and which, if cut during the operation, may cause troublesome hæmorrhage. The trachea runs downwards and backwards; it is therefore nearer the surface and more easily reached in the upper than in the lower part; hence the advantage of the high over the low operation. Moreover, besides its greater depth, the close proximity of the large vessels of the neck, as well as occasional abnormalities in their origin and course, render the low operation not only more difficult but more dangerous.

The *size of the trachea* varies; in young subjects it is disproportionately small, or, in other words, the larynx and trachea undergo special development after about the twelfth or fourteenth year of life. In twenty-four cases taken without selection, mostly from young subjects, male and female, the writer found the average diameter to be .374 of an inch. The cases included one adult male, aged twenty, with a diameter of .550; a boy, aged thirteen years, with .475; and a girl, aged eleven years, with .425. The average diameter of twenty cases, boys and girls of eight years and under, was .356. These latter cases included an infant, aged ten weeks, with .300; a boy, aged two years and two months, with .275; a girl, aged three years and nine months, with .500; also a girl, aged eight years, with .500. Thus, the trachea varies in size with the growth and development of the child, rather than with its age. The above figures will give an idea of the size of the tube which may be required. In adults the differences in size are of less moment, as the trachea is larger in proportion to the body, and far larger than any tracheotomy-tube which can be required.

Various methods of operating have been proposed. Thus, a trocar and canula, suitably shaped, have been used by some surgeons, while others have tried the actual cautery; the ordinary plan of using a scalpel is the only method which will be described in this place. The surgeon will have first to decide whether an anæsthetic

shall be administered or not. In a great many cases, especially in young children, an anæsthetic will be of the greatest service; if administered slowly and without constraining the patient too much, it never does harm. See LARYNGOTOMY. If the patient is old enough, and has the courage to keep himself quiet, the anæsthetic may be dispensed with. The recumbent position is the most convenient for operating, with the head thrown back in order to make the trachea stand prominently forward. Then, with the index finger of the left hand the cricoid cartilage should be felt for and its exact position ascertained; in thin subjects there will be no difficulty, but in short, fleshy necks, especially if the thyroid gland or its isthmus is large, the cricoid cartilage is not always easy to make out.

An incision, having the cricoid about or a little above its centre, is now made in the median line of the neck, when the sterno-hyoid muscles, separated by a linear interval, will be seen through the superficial layer of the cervical fascia; the sterno-thyroid muscles are immediately beneath, also separated from each other by a narrow interval. The incision must next be carried through this interval, any veins which meanwhile present themselves being drawn aside. By keeping exactly in the median line, the danger of hæmorrhage is greatly lessened. After the muscles have been drawn aside by blunt hooks, the trachea will come into view; perhaps the thyroid isthmus, if very high or very large, may be found in front of the trachea. In the latter case it must be depressed by means of a blunt hook, after cutting through the fascia by which it is bound down to the trachea. Or the isthmus may be deliberately cut through, if it is seriously in the way and the case is an urgent one.

The trachea having been well exposed, the first three or four rings may be incised *from below upwards*. In young children, owing to the shortness of the neck, the space is very limited, and it will generally be found advantageous to include the cricoid cartilage in the incision, thus converting the operation into a crico-tracheotomy. It is very desirable that the opening should be as ample as possible, for besides facilitating the introduction of the tube, it gives better access to the trachea, and allows the surgeon to carry out his after-treatment with greater ease and certainty. The trachea having been incised, a dilator is introduced, and the opening kept patent. No further anæsthesia will be required; a

good deal of irritation and coughing usually ensues, by which mucus and any blood which may have penetrated are expelled.

The subsequent proceedings depend on the nature of the disease which has called for the operation, and will be discussed farther on *seriatim*. The introduction of the tube is usually accomplished without difficulty, provided a median and ample incision into the trachea has been made. As regards the *size* of the tube, it may be laid down that the largest tube which can be got into the trachea without violence, and the shortest which can be well retained, should be used.

The *shape* of the tube is of great moment. It has already been stated that the direction of the trachea is downwards and backwards. A quarter-circle tube is, therefore, obviously unsuited for the purpose. Some years ago the writer proposed, and has since extensively used, an 'angular tube;' this has been found to be comfortable to the patient, as well as free from the inconveniences which an ill-fitting quarter-circle tube so frequently gives rise to. In gauging the calibre, the innertube must always be taken; the smallest diameter at any point determines the available size for breathing purposes; tapering tubes should always be avoided; the inner tube should project slightly beyond the outer. In a few urgent cases the patient ceases to breathe before the operation can be completed. When this occurs, the operator should complete the operation, put in the dilator, and having cleared away any mechanical impediments to respiration, should then practise artificial respiration. It is rare not to be able to re-establish respiration.

After-treatment.—This depends altogether on the nature of the lesion which has called for the operation. Undertaken for the removal of a foreign body, if not coughed out after the trachea is opened the foreign body must be searched for with suitably curved forceps, or a sling of bent silver wire, or a trachea-aspirator. Auscultation or the patient's sensations will probably indicate its position, and the surgeon will use the means which seem most appropriate to the individual case. After its withdrawal, the opening in the trachea need only be covered with wet lint, unless any secondary conditions in larynx, trachea, or lungs indicate that a tube should be worn. In the former case, the wound will probably heal in a few days; in the latter, recovery will be more gradual, and dependent on the nature and extent of the secondary lesions. See FOREIGN BODIES IN THE AIR-PASSAGES.

If the operation has been undertaken on account of respiratory obstruction due to papilloma in the larynx, a tube will have to be worn until the cause of the obstruction has been removed. If malignant growth have spread to the larynx or trachea, the tube will have to be worn indefinitely; the chief object of the after-treatment consisting in keeping the discharges as sweet as possible, and in facilitating their exit from the trachea.

This will be best accomplished by the application of disinfecting solutions or powders; among the former, glycerine of boracic acid, or of carbolic acid, or of alum will be found most useful; they may be applied through the tracheal opening with a soft brush or a feather; among the latter, iodoform blown in with an insufflator will be found efficacious. The use of a spray from time to time, the patient breathing it into the lung as much as possible, will help to ward off septic pneumonia, so fatal a complication in these cases. The occasional application to the eroded surfaces and adjoining part of a solution of cocaine will add much to the comfort of the patient, by diminishing pain and reflex irritability. In cases of paralysis of the laryngeal muscles; of injury to the larynx with secondary swelling or ecchymosis of the mucous and sub-mucous tissues; of stricture following ulcerative processes, the tube will have to be worn until the condition causing the obstruction has passed or subsided. Besides keeping the tubes quite clean, no special after-treatment, as regards the tracheotomy wound, will be required. In all such cases great care must be used in selecting a well-fitting tube, or secondary ulceration may ensue.

It is in cases of diphtheria that after-treatment becomes of such special moment, not only because of the dangerous nature of this disease, but because children are the chief sufferers. If the purposes of the operation be kept in mind—viz. the admission of air into the lungs, and the removal of the false membrane (which is infective as well as obstructive)—the nature of the after-treatment will be obvious. Immediately after incising the trachea, while it is being held open by the dilator, and before the tube is put in, an effort must be made to clear out all membrane and retained secretions; for this purpose a good long feather answers admirably. After being soaked in a solution of sodium or potassium bicarbonate and glycerine (3ij. and f3j. respectively to half a pint of distilled water), this feather should be passed into the

trachea and twirled about so as to detach the membrane, that it may be coughed out; the feather may then be passed up into the larynx and through the glottis, and all membrane thoroughly cleaned out. This proceeding may have to be repeated several times. Besides the feathering, some of the potash solution may be sprayed into the wound; it will be found to moisten, dissolve, and detach secretions, and so aid their expulsion. In a few cases, even this does not suffice to clear the air-passages; then aspiration must be tried. This is most effectually accomplished with the writer's 'tracheal aspirator;' the plan, moreover, is free from danger. To suck a tracheotomy wound is, worse than useless, for if the secretions are adherent they cannot be sucked out, and if they are loose they will be coughed out spontaneously. It is very necessary that the tubes be taken out and changed, the outer tube once in twenty-four hours, the inner tube every hour or two according to the amount and tenacity of the discharge.

It is a very useful practice to place all tracheotomised patients in a 'croup-bed'—that is to say, in a bed surrounded with thick curtains—and to keep the air warm and moist. For this purpose, Allen's croup-kettle, made at the suggestion of the writer, is the most simple and efficient means; by it the amount of heat, as well as of steam, can be nicely regulated; an excess of steam is injurious. One of the advantages of a 'croup-bed' is that the room can be thoroughly ventilated, without exposing the patient to any draught or change of temperature.

The *final removal of the tracheotomy tube* can only be thought of when the disease has been arrested or the foreign body removed. In malignant cases, in syphilitic disease, after injuries leading to cicatricial narrowing, a tube may have to be worn permanently. As a rule, in acute cases an attempt to dispense with the tube should be made about the fourth day, and repeated at longer or shorter intervals until the breathing through the natural channel can be re-established.

COMPLICATIONS.—These may be briefly described as *immediate* and *remote*. The former are more or less acute, coming on within a few hours or days of the operation, and may appropriately be called 'wound complications;' these include diphtheria of the wound, inflammatory oedema of the neck, and erysipelas. The latter are generally chronic, and include pharyngeal catarrh, laryngeal catarrh,

irritative changes due to the presence of a tube, and ulceration due to an ill-fitting tube.

Immediate Complications.—Diphtheria of the tracheotomy wound is comparatively rare; a sloughy and unhealthy condition (which is sometimes mistaken for diphtheria) is very common. Trousseau, to obviate this tendency, recommended that 'during the first four days, the entire surface of the incision should be vigorously cauterised once a day; one may thus avoid a very redoubtable complication, the diphtheritic infection of the wound.' Should this really occur, active measures must be taken; the surface may be touched once or twice with a mixture of equal quantities of hydrochloric acid and of glycerine, whereby a simple will be substituted for a specific inflammation. The free use of the spray, and the application of glycerine of boracic acid, as previously recommended, are excellent prophylactic measures. Oedema of the neck is a much more frequent complication. To a small extent it occurs after all operations. Sometimes, owing to unusual difficulties in opening the trachea, the intermuscular planes are too freely opened up, and the cellulitis assumes dangerous proportions. It may or may not be complicated with erysipelas—that is to say, with involvement of the skin. Sometimes severe erysipelas occurs on the surface, without appearing to affect the deeper layers. In either case their occurrence adds to the gravity of the disease for which the operation has been undertaken. Treatment must be both local and general. As a local application, nothing answers so well as lactate of lead—one drachm of liq. plumbi to a fluid ounce of fresh milk—which should be brushed thickly over the inflamed parts, and be frequently renewed. Internally, quinine and iron should be given.

Remoter Complications.—Chronic pharyngitis, with or without enlargement of tonsils, not infrequently supervenes, in weakly subjects, on an attack of pharyngeal diphtheria or scald. The condition is chiefly of interest because it may interfere with the permanent removal of the tube. The most appropriate local treatment is alum, either in the form of a saturated spray, or with glycerine, which latter must be brushed on several times a day. Cod-liver oil and steel wine, alone or combined, should be given internally. Chronic laryngitis is another sequel, and one which often causes considerable delay in removing the tube; in these cases, there are stridor in

breathing, chiefly with inspiration, hoarseness of voice, and sometimes troublesome cough. Alum solution must be sprayed into the larynx, or glycerine of alum be applied with a laryngeal brush. Occasionally, it is advantageous to paint the vocal cords and neighbouring parts with a solution of nitrate of silver (10 to 20 grains to the fluid ounce of distilled water). This chronic laryngitis is sometimes kept up by, and may be due to, the irritation which the presence of a tube causes, even when the tube fits well, for some tracheæ are so hypersensitive that they never become habituated to the presence of the tube. In such cases every means must be adopted to lessen the irritation; the use of cocaine will prove of great value. Ulceration within the trachea, generally on the anterior wall, about the spot where the lower extremity of the tube impinges, was formerly a frequent complication after tracheotomy. Since M. Roger of Paris drew prominent attention to it, and to the part which ill-fitting tubes played in its production, ulceration has become much less frequent; the remedy for such cases is obvious. It must be stated, however, that complications are much less frequent in cases of injury or morbid growths requiring tracheotomy than in disease. *See* TRACHEOTOMY TUBES.

ROBERT WILLIAM PARKER.

TRACHEOTOMY TUBES are employed to maintain a free passage for the entrance of air into the trachea, from an artificial opening in the neck, in cases where there is an obstruction to its entrance through the larynx. The tubes are made of either silver, india-rubber, vulcanite, or celluloid, and are fashioned according to numerous patterns.

There are several requisites in a good tracheotomy tube: it should be easy to introduce; it should be composed of two canulæ, one of which fits within the other, and projects a little beyond it at its deep extremity. The mucus which is so abundantly secreted in the trachea collects in successive layers within the tube, narrowing its calibre and impeding the passage of air through it. The mucus forms a coating of leathery consistence, which it is quite impossible to detach by means of a feather, and so it is frequently necessary to remove the canula in order to clear it away. If there were only one tube its removal might cause dyspnoea, and considerable difficulty might be experienced in replacing it; with the double tube this difficulty is overcome, for the

patient can breathe through the outer tube whilst the inner one is being washed. The mucus adheres to the extremity of the tubes; so it is obvious that, if the inner tube were of the same length as the outer one, the mucus collected about the extremity of the latter would offer an obstruction, however clean the former were kept.

A good tracheotomy tube should inflict the least possible injury on the trachea; to ensure this, the portion of the tube within the trachea should lie exactly in the axis of that channel, so that the free extremity of the tube does not project against its walls. The tube should be capable of as little movement within the trachea as possible, and with this object it should be as large as can be got into the trachea without inflicting injury during its introduction. The shield, which is attached to the surface extremity of the tube in order to prevent it slipping into the trachea, should be movable, for, if it be rigidly fixed to the canula, any movements of the neck or of the trachea are liable to cause the canula to injure the mucous membrane. The inner canula ought to be capable of easy introduction and removal; if it fit tightly, there is some liability of injuring the trachea by pressing the outer tube against its posterior wall. This can be avoided if care be taken to support the outer tube by the fingers, whilst the inner one is pressed home with the thumbs, but, as the removal of the inner tube is often entrusted to nurses, it is desirable that it should slip in easily, without any forcible pressure.

Fuller's silver bivalve canula has been largely used. It is a quarter-circle tube, and is composed of two canulæ: the outer one is rigidly fixed to the shield, and is split down the middle so as to allow of its two halves being pressed together. This contrivance makes it easy to introduce the outer canula, but considerable force is required to push home the inner one, as it has to press the two valves apart and to dilate the opening in the trachea; in doing this, the sharp extremities of the outer canula will be pressed against the trachea, unless care be taken. Sankey has contrived a pair of forceps which still further facilitate the introduction of the outer canula; the blades of the forceps are passed through slits in the shield and made to grip the two valves and so compress them. Jessop has had the valves attached to the shield by means of a hinge, which allows of their being more easily separated; this modification lessens the pressure required to introduce the inner tube, and also facilitates the cleansing of the instrument.

The quarter-circle curve of these instruments is objectionable, as has been especially pointed out by R. W. Parker; he has shown that, when the tube is in the windpipe, the convex surface presses against the posterior wall of the trachea, whilst the front of the lower extremity of the tube tends to press on the anterior surface of the trachea, and set up ulceration at that site.

Durham's tracheotomy tubes are a great improvement on the quarter-circle canulæ. They are made of silver, and are only curved towards the lower end; they are provided with Roger's movable shields, and there is, further, a movable collar, to which the shield is attached, and which can be firmly clamped at any position along the straight portion of the tube. When in use, the portion of the tube beyond the curve should alone rest in the trachea, and to ensure this, the movable collar should be fixed at such a position as is required by the depth of the trachea from the surface. The shape of these tubes is such that a rigid inner canula could not be introduced, so the lower part of the latter is furnished with lobster-tail joints. A similarly jointed pilot, which projects with a blunt point just beyond the lower end of the outer tube, greatly facilitates the introduction of this instrument into the trachea.

Bryant's tracheotomy tube has a quarter-circle curve, but the intra-tracheal portion is freely movable with the trachea, owing to the canula being attached to the shield by a ball-and-socket joint.

R. W. Parker's tracheotomy tube is bent at an angle, which he has found, by examination on the subject, ensures its lying in the axis of the trachea. This is a most important modification, for by means of it the tendency of the tube to cause ulceration of the mucous membrane is reduced to a minimum. The tube is provided with an inner canula, which projects beyond the outer one; owing to the shape of this tube, a complete inner canula could not be introduced, so the latter is made without a posterior wall, except at the upper and lower extremities. The inner canula slips into position almost by its own weight, and can be firmly secured by a clip at the upper end. The instrument is provided with Roger's movable collar. It will be seen that this instrument possesses all the essential factors of a good tracheotomy tube.

Morrant Baker has introduced india-rubber tracheotomy tubes; they are made of vulcanised red india-rubber, and are sufficiently firm to withstand ordinary pressure, though not rigid enough to cause

ulceration of the tracheal mucous membrane. These tubes are not intended to be used until twenty-four hours after the operation. Walsham has devised a pair of curved forceps, which can be passed along the tube and then opened so as to stretch it to the shape of the opening in the trachea, and thus facilitate its introduction.

Tracheotomy tubes should be securely tied into the trachea with a piece of tape. The tape should be threaded through a slit in one end of the shield, and the two ends of the tape should be carried behind the neck to the other side, where one end of the tape should be threaded through the slit in the other extremity of the shield, and then the two ends of the tape should be tied together at the side of the neck.

Difficulty is sometimes experienced in cleaning the inner canula; this is best done by pouring over it boiling water, to which some common salt has been added.

It is a difficult point to decide when a tracheotomy tube may be safely left out; some assistance may be gained by the employment of Lauer's ball-valve, which can be fitted to the orifice of the canula, or by using T. Smith's india-rubber valve, or Gresswell's tracheotomy tube, the free extremity of which is perforated with lateral holes, and is provided with a cap which can be screwed on so as to close the holes gradually more and more completely; as this is done the patient will breathe more through the glottis, and through a hole in the convex surface of the intra-tracheal portion of the tube. When, by any of these means, it is found that sufficient air can be inspired through the glottis, the tube may be removed. BILTON POLLARD.

TRANSFUSION. — Various methods of transfusion have been proposed, and a vast amount of useless ingenuity exercised on the invention of machinery for its performance; but since the accurate knowledge of a single, safe and certain method, which can be applied on an emergency, is of more value to the practitioner than the names of a dozen different plans with complicated apparatus, one method only will be described.

The writer proposes, therefore, merely to give the method of transfusion of which he has had actual experience, having recently performed the operation on two occasions for the late Dr. Mahomed, in each of which there was not the slightest difficulty in transfusing from 30 to 40 drachms of blood. The method is simple and certain, if care

be taken to follow the directions laid down. The apparatus used is that of Aveling, slightly modified in its size and structure by the writer. The instrument must be made of the purest rubber. It is like a miniature Higginson's syringe, with the exception that it has no valves. It consists of an oval ball made to hold two drachms. At either end of the ball and directly continuous with it is an india-rubber tube 8 inches in length, having an internal diameter of a No. 4 catheter. Two silver canulæ $2\frac{1}{2}$ inches long, made conical in shape with rounded points, of the diameter of a No. 2 catheter at the apex, and of such a size at the base that the india-rubber tube will fit tightly over them, are provided.

The apparatus now consists of a simple tube with a dilatation in the centre, terminating in a canula at each extremity. This syringe, destitute of valves, is filled with a warm solution of salt and water. This filling is easily accomplished by squeezing the ball a dozen times or so in a bowl of salt solution. When filled, a bulldog clip-forceps on the india-rubber tube, close to the canula, will prevent the escape of the water on transferring the syringe to position.

The arm of the giver of the blood is then compressed by three or four turns of a bandage high above the elbow. This makes the veins stand out prominently, and a suitable one about the bend of the elbow can be selected. The skin, being drawn a little to one side of the vein, is incised to the extent of $\frac{3}{4}$ of an inch, the incision going well into the subcutaneous tissue. On the skin being let fall back into its place, the vein shows clearly blue and distended in the incision. If it does not show clearly, it must be cleanly exposed by a little dissection of the surrounding subcutaneous tissue with the point of a director. The exposed vein is then temporarily covered over with a warm sponge, and the operator next exposes the vein in the arm of the recipient. This is not so easy, for, owing to the bloodless condition usually present, the veins are not so conspicuous. However, by pressure above them one of sufficient size can be selected. The exposing of the two veins completes the first stage of the operation.

The second stage consists in opening the veins, and in introducing the canulæ. A small table should be placed at the side of the bed, covered with a blanket. On this table the arm of both the giver and the recipient are laid, the giver being seated on a very low chair or stool. A portion of the

vein of the receiver is now gently seized with a pair of forceps, and opened by dividing a part of the vein transversely just below the forceps. At the moment of doing this the little finger of the left hand, which is holding the forceps, should be pressed upon the vein, a little below the point at which it is opened. This controls the bleeding, and enables the operator to see exactly the little hole he has made in the vein. He is thus able to introduce the canula without difficulty. The hole made must be very small, so that, as the conical canula is passed up into the vein, it will fit tightly into the opening. The canula at the other end of the syringe is introduced in the opposite direction into the vein of the giver. An assistant is instructed to keep both canulæ in position with his hands.

The operator then proceeds to perform transfusion as follows. The clips having been removed from the tube at either end, the operator makes the necessary valve to prevent regurgitation by compressing with the finger and thumb of one hand the tube between the central ball and the giver. He then slowly squeezes the ball, with the effect of driving the water it contains gently into the vein of the recipient; then, having compressed the tube between the ball and the recipient, he removes the finger and thumb from off the tube on the opposite side, allowing the ball to expand with the blood coming into it from the arm of the giver. When the ball is full the manipulation just described is repeated, and the blood passes into the vein of the receiver. In this manner, each time the ball is compressed two drachms of blood are injected into the veins of the patient. Should the syringe appear to become blocked or work unsatisfactorily, it can be detached and washed out without removing the canula from the veins. Roussell's apparatus is strongly advocated by the inventor, but to those who have had experience of the two methods, there is no shadow of doubt that Aveling's apparatus is vastly superior. Roussell's plan is most unsurgical, and is merely an attempt to substitute the haphazard, blind puncture of a machine for the human fingers and eyesight, which alone are to be relied on in performing so delicate an operation as transfusion with ease, safety, and precision.

HARRISON CRIPPS.

TRAUMATIC ANEURISM. See ANEURISM.

TRAUMATIC FEVER.—The term traumatic fever has, up till the present

time, been vaguely employed to denote pyrexia of any kind following injuries of all sorts. Thus, it has been applied to all the kinds of pyrexia which commonly occur in surgical practice, and have therefore acquired the colloquial but misleading title of **SURGICAL FEVER**. It is time that the term traumatic fever should be restricted to that class of cases in which pyrexia follows the infliction of a simple injury—i.e. one which, while causing a lesion of tissues, does not rupture the enveloping skin or mucous membrane, and, consequently, one which is not complicated by external septic influences, nor by the application of antiseptic substances to the wounded tissues. Even when the term is thus limited to such cases, we find that there are, clinically speaking, two conditions which each possess a distinctive form of pyrexia, and in which there is a difference in the detail of their causation. Thus, as a result of traumatism, we find that an injury involving fracture of a bone, with moderate rupture of the surrounding tissues, may under proper treatment be repaired without further adverse consequences; while another one, more violent perhaps, and possibly situated in the neighbourhood of large blood-vessels, will give rise to a series of changes, marked by congestion and œdema of the parts on the distal side of the injury. These two results of simple traumatism vary as much in the kind of pyrexia they produce as they do in their clinical features, and they will therefore be described as two distinct varieties of traumatic fever.

Symptomatology.—The general symptoms of traumatic fever, besides the pyrexia, are usually so slight as to escape notice in the large majority of cases, and, when they do occur, are practically summed up in those of headache and loss of appetite. These remarks apply rather to the first of the two varieties about to be described, since in the second the general symptoms are frequently prolonged and more severe.

The most important symptom, then, is the pyrexia, and this follows such a very definite course as to admit of the cases being grouped, clinically, into the two varieties. In the first variety, the temperature rises almost immediately after the single injury, reaching nearly its maximum within the first two hours, but gradually rising to that point during the first twenty-four hours. It then very slowly falls to normal in about a week. The intensity and duration of the pyrexia are both somewhat modified by the age of the patient, for, in

individuals beyond middle age, the temperature rises to half the height it does in younger patients, and, moreover, lasts half as long.

In the second variety, instead of the temperature rising very suddenly nearly to its maximum, it rises rather more gradually (but still within five hours) to about half its ultimate height, and from this point it steadily rises for forty-eight hours, when it reaches its maximum. From this highest point, which averages 101° F., it falls till about the 120th hour after the accident, when it rises again to about 100° , and then falls to normal in three or four days. The second rise, just described, is peculiar to this class of cases, and the pyrexia is frequently continued for nearly a fortnight. Clinically, this variation in the pyrexia is accompanied by a very noteworthy difference in the condition of the limb. In the first variety, the limb is scarcely, if at all, swollen, and there is very little ecchymosis; but, in this second class there begins, soon after the accident, a gradual swelling of the limb, which reaches its height with the temperature, and, as noted above, the patient suffers from greater constitutional disturbance.

Pathology.—In both of the varieties of traumatic fever, just described, there is, in the very large majority of cases, one constant factor in the production of pyrexia, and that is, the fracture of a large bone, with the necessary accompaniment of some extravasation of blood and rupture of soft tissues. While admitting that the rupture of such important tissues as bone and muscle is nearly the determining factor in the production of the traumatic fever described as the first variety, it must be evident that, in the second class, we have a further effect on temperature superposed on that just described—an effect which is just as clearly due to the tension of the œdema of the parts around and below the fracture. In both varieties, then, we have pyrexia and the other symptoms of fever produced by a simple injury, and this, consequently, alone deserves the name ‘traumatic.’ In the present state of knowledge concerning the causation of fever (*see* **SURGICAL FEVER**) in general, it is impossible here to do more than point out how much peripheral irritation of nerve-trunks there must be in the seat of a fracture, &c.

Prognosis.—Traumatic fever of itself is quite harmless, and never leaves any injurious sequelæ.

Treatment.—The treatment of traumatic fever is perhaps the least important,

if not the least interesting, side of the subject, for the whole treatment of a case resolves itself into preventing œdema and inflammatory changes at the seat of injury.

Nothing has been said above, purposely, concerning the delirium which sometimes occurs in cases of traumatic fever, for the reason that it can nearly always be traced to alcoholism, fat-embolism, &c., so as to leave pure traumatic delirium a matter requiring further investigation.

VICTOR HORSLEY.

TRENDELENBURG'S TRACHEA-TAMPON is an instrument which was devised to prevent the trickling of blood into the windpipe in operations about the jaws, palate, and pharynx, and also to facilitate the administration of the anæsthetic during such operations. It consists of a tracheotomy tube, which is surrounded by a hollow elastic collar at the part of the tube lying in the trachea; by means of a small syringe, this collar can be inflated and distended. When employing this instrument, the trachea should be opened in the usual manner and the tube introduced; the further administration of the anæsthetic should be carried on through the tube. Just before the operation is begun, the india-rubber collar should be inflated sufficiently to ensure its plugging the trachea completely. By means of this tube and tampon the gravitation of blood into the bronchi is prevented, and the anæsthetic can be given without in any way incommoding the operator. After the completion of the operation the tube may be removed, and, if necessary, an ordinary tracheotomy tube may be substituted for it. It is found in practice, however, that the inflation of the india-rubber collar is apt to produce irritation of the trachea and troublesome cough, and that a more satisfactory result can be attained by using an ordinary tracheotomy tube, and plugging the upper aperture of the larynx with a sponge, to which a string should be attached for safety.

BILTON POLLARD.

TREPHINING. See SKULL, Fracture of the.

TRICHIASIS—Inversion of the Eyelashes. See EYELIDS, Diseases of the.

TRICHINOSIS. See MUSCLES, Affections of.

TRICHOPHYTON TONSURANS. See TINEA TONSURANS.

TRICHOREXIS NODOSA. See HAIR, Diseases of the.

TRISMUS NASCENTIUM. See TETANUS.

TROCARS are instruments used for puncturing and evacuating the contents of cavities; they are usually provided with canulæ or hollow ensheathing tubes, through which the contents of the cavities may be drained away when the trocar has been removed. The above description refers to the trocars in common use for tapping hydroceles of the tunica vaginalis, or for tapping the bladder through the rectum. The trocar is solid and spear-pointed, so that it makes a triangular and slightly contused wound, which, if small, heals readily enough, though, if large, it may not do so. To meet this objection, the large trocars which are used for puncturing ovarian cysts are made hollow, and have a sharp and bevelled extremity, so that the wound made is a semilunar cut, which will readily heal.

The older cyst-trocars were provided with a blunt ensheathing tube or canula, with a truncated end. After the cyst had been punctured, the canula was pushed on so as to guard the point of the cutting tube. More recently, the canula has been placed within the cutting tube, and its extremity has been made dome-shaped, and the sides just behind the extremity have been perforated with large holes. The advantage of the latter alteration is that, if the cyst-wall or a secondary cyst come in contact with the end of the instrument, it is not likely to obstruct all the apertures. Some trocars are provided with a cutting blade for a short distance behind the point, so that the deeper parts of the puncture may be enlarged, if it be desired. Others, again, are grooved on one side, so that the instruments may be used as directors as well as trocars. The following are some of the more common special trocars.

Spencer Wells's cyst-trocar is a hollow instrument with a pen-shaped cutting extremity and an outer ensheathing tube, which can be pushed on so as to guard the point. When the instrument is meant for tapping ovarian cysts, preparatory to their removal, it is provided with spring claws for seizing and holding the cyst-wall just beyond the punctured portion.

Fitch's cyst-trocar differs from the last in the puncturing sharp point of the trocar being on the outer tube instead of on the inner one, as in Sir Spencer Wells's original

instrument. Dr. Fitch has recently had the canula made dome-shaped, and perforated with large holes just behind the extremity.

Ponteau's trocar, for tapping the bladder *per rectum*, is a long, curved, sharp-pointed solid instrument carrying a simple canula, which is provided with a shield.

Cock's trocar, for the same purpose as the last, is composed of five pieces—a blunt pilot trocar, a sharp-pointed trocar, and three canulæ. The outside canula is first introduced into the rectum by means of the pilot trocar, and held firmly in position; the pilot is next withdrawn, and the sharp trocar substituted for it; the base of the bladder is then pierced in a direction towards the umbilicus and the trocar removed, leaving the canula in position. A second tube with an expanding extremity, adapted to retain the canula in position, is next introduced, and within the second tube a third is placed in order to keep the second in its place.

Pearse's trocar, for suprapubic puncture of the bladder, consists of a trocar and canula suitably curved for the purpose, and of a catheter which fits the canula accurately and extends a little beyond it; the outer end of the catheter turns downwards at a right angle, in order to convey the urine away through an india-rubber tube.

Harrison's trocar, for tapping the bladder from the perineum through an hypertrophied prostate, consists of a hollow straight trocar, through which the urine flows as soon as the point has penetrated about half an inch into the bladder. The canula is provided with a movable shield, which can be fixed in any position so as to suit the size of the prostate and the depth of the perineum; there is also an inner canula with a blunt expanding extremity, which prevents the instrument slipping out of the bladder.

Southey's trocars are fine instruments, provided with canulæ which are scarcely larger than the needle of a hypodermic syringe; the canulæ are perforated with four holes on each side, and their outer ends are made a little bulbous, in order to retain pieces of capillary india-rubber tubing through which the fluid removed may be drained away. The instruments are used for the gradual removal of ascitic fluid, and for draining away the serous effusion into the subcutaneous tissues, in unyielding cases of crural dropsy.

The harpoon trocar, or *emporté-pièce*, is a hollow trocar with a spear-pointed end and an aperture just behind it, through

which the harpoon may be projected and then withdrawn again within the tube. It is used to remove pieces of muscle in suspected cases of trichina disease, or in other cases where a little of the tissue is desired for microscopic examination.

BILTON POLLARD.

TRUSSES are appliances of various forms and of divers materials, which serve, in the case of reducible herniæ, to retain them within the abdominal cavity, and, in the case of irreducible herniæ, to prevent their increase and, ultimately, by pressure, to procure their complete reduction. A truss should exert an amount of pressure a little in excess of that required to retain completely the hernia, under all conditions and in all positions of the body.

Trusses are composed of different materials: elastic, as steel or vulcanite; inelastic, as leather, calico, or jean. Those formed of inelastic materials are not reliable, as they fail to exert a sufficient amount of pressure to keep the protrusion retained in any variety of posture; they are, however, occasionally serviceable in cases of large irreducible inguinal and umbilical herniæ. Those composed either of steel or vulcanite are alone capable of exerting the requisite amount of persistent, uniform, and pliant pressure.

Trusses should possess the qualities of lightness, pliancy, and adequate firmness; and these are best fulfilled by steel, which, after being pared from the sheet, should be carefully forged so as to render it more tough and ductile. The hammering of the steel at a blood-red heat, moreover, enables the artisan to give the truss the necessary thinning and tapering of the end opposite to the pad. Subsequently, the steel must be hardened and tempered. It is only by these means that the truss can be accurately adapted to the body of the wearer, clasping it at all points; firmly on the side of the hernia as far as the base of the sacrum, thence gradually lessening as it curves round the opposite iliac bone.

The basis of the truss is a narrow oval band of hardened and well-tempered steel, to the thicker end of which (in the case of a single truss) is firmly rivetted a slightly concave oblong head, which should not exceed two and a half inches in length, and an inch and three-quarters in its broadest diameter. The spring may be variously cranked so as to alter its pitch, thus allowing it to exert uniform and upward pressure according to the stoutness or thinness of the wearer. To the head is attached

a piece of cork, which forms the base of the pad, of the shape of a pear cut through, the narrow end being towards the shoulder. The pad, under ordinary circumstances, should be three and a half to four inches in length, an inch and a half to two inches and a half broad, and three-quarters of an inch in thickness. Over the inside of the spring and pad are laid three layers—one of glazed cotton and two of flannel; and, lastly, the whole is covered on the outside with calf and on the inside with chamois leather. To the outside of the steel head are affixed two studs, placed obliquely. To the upper one is attached the transverse cross strap; to the lower one, the under strap.

In the femoral form of truss the spring is weaker, the curve from the shoulder is more oblique, and the pad is smaller, and more hollowed on its outer side to prevent pressure on the femoral vein.

The under strap should always be worn, for it serves to maintain the truss in position, and prevents the pad from riding up during exercise. Air or water pads are sometimes substituted for cork, affording in some cases increased comfort to the wearer, but giving no additional security.

The form of truss best adapted for the large majority of herniæ is that known as the German serpent-spring truss, which more accurately than any other encircles the pelvis immediately below the crests of the ilia, affording at the same time gentle pressure when the body is at rest, and firm and increasing pressure when it is in action.

The truss, whether inguinal or femoral, should be adjusted high up behind, resting upon the base of the sacrum, immediately below the crests of the ilia; the pads terminating in front, in the inguinal form about one-sixth of an inch above the spine of the os pubis, and in the femoral form one-sixth of an inch to its outer side; the pressure of the pad being in the former case on the inner ring and the inguinal canal, and in the latter case on the femoral canal and the saphenous opening. The truss should be adjusted before the patient rises from bed, and be taken off after he has retired to rest. Irritation of the skin occasionally results from retention of perspiration, especially during hot weather; this is best obviated by washing the skin well every morning and, after careful drying, dusting it over with some powdered oxide of zinc.

The measurement for a truss, be it inguinal, femoral, or umbilical, should be taken in the following manner: A measured tape is to be drawn fairly tightly round the pelvis just below the crests of the ilia, and

the two ends made to meet above the symphysis pubis, when the number in inches can be read off.

A truss should be applied as soon as the hernia is discovered, no age being too young for an instrument to be worn, even though the patient be only a few days old. The object of the truss is not only to retain the hernia within the abdomen, but, in a large number of cases—especially in those under ten years of age—to obtain a radical cure. The percentage of cures is necessarily difficult to ascertain, but, without doubt, the large majority of children do, sooner or later, become cured. When the frequency of hernia in early infancy is considered, and its comparative rareness in early adult life, as taken from the statistics of large educational establishments, it is fair to infer that the lesion has—temporarily, at any rate—been outgrown. In support of this it may be shown that in six years, at the City of London Truss Society, 6,268 boys up to the age of five years were supplied with trusses, while only 1,174 were relieved between the ages of eleven and fifteen years. In one large institution, containing over 800 boys, not one was the subject of hernia.

In infancy, the truss should be worn constantly, only being removed three or four times in the day for the sake of cleanliness. It is well to keep the parts well dried, and to absorb all moisture.

In adults, the truss may be taken off at night; but if there be any descent of the hernia, it should be kept constantly applied, and only removed night and morning for the purpose of washing. The truss should be adjusted when the patient is lying down, and care must be taken that the whole of the hernia is replaced before the truss is put on.

It is difficult to forecast the length of time required before a cure can be expected and the use of the truss discontinued; for the general deductions on this point the reader is referred to the article *HERNIA, Reducible*.

In *inguinal hernia*, owing to the largeness of the rupture, the patency and approximation of the rings, and the difficulty of retention, it is often necessary to devise special instruments. Thus a hernia in the funicular portion of the tunica vaginalis is usually not kept up by an ordinary truss, and may require a rat-tail truss, which consists of a triangular prolongation of the soft part of the pad. A large, direct, inguinal hernia, again, can only be retained by a forked-tongue truss, to which, in addition to the rat-tail, is attached a soft transverse

portion crossing the pubes, and buckling to the shoulder of the opposite side.

In irreducible inguinal hernia a hinged-cup truss is usually needed, which not only supports the protrusion but, by its constant pressure, procures its reduction. This truss consists of a triangular rim-plate covered with chamois leather, attached by an oblique hinge to the lower part of an ordinary inguinal pad. If the hernia be a large entero-epiplocele, a suspensory bag of some strong inelastic material may be the only appliance which can be tolerated.

Besides these there have been many other trusses devised, and the ingenuity of the surgeon is often taxed to design proper and efficient trusses to meet the varying degrees of hernia.

In *femoral hernia*, if the ordinary truss does not answer its purpose, it is well to affix to the pad a thigh-belt with a triangular fulness to fit into Scarpa's triangle. In some large protrusions after herniotomy, it may be necessary to supplement the thigh-belt with an inguinal fulness to buckle to the shoulder of the opposite side. If the hernia be irreducible, which is very frequently the case, the pad should be more or less cupped so as to embrace the hernia, the cup being comparatively small, so as to afford persistent pressure.

Umbilical herniæ, a large percentage of which are irreducible, are best treated by a shallow, circular, concave plate, which not only compresses the hernia but, at the same time, supports the lower part of the abdomen. Nipple-shaped prolongations from the plate to fit into the umbilical aperture are unadvisable, as they tend by their wedge shape to gradually enlarge the opening. See UMBILICAL HERNIA.

When the hernia is very large and irreducible, it often increases the patient's comfort to apply, first, a broad abdominal bandage, and over this to adjust the ordinary umbilical truss.

Although the circular spring truss, with its modifications, fulfils better than any form of truss all the requirements needed for the retention of herniæ generally, yet there are other forms which, under occasional conditions, supply important and practical advantages. Of these varieties the following are the more important:—

Salmon and Ody's truss consists of a semicircular spring, provided in front with an oval, slightly convex pad, which moves on a ball-and-socket joint, and having behind a circular flat pad to rest on the spine. It is adjusted round the pelvis *opposite* to the side of the hernia, and is usually worn

without a cross strap or an under strap. It is especially useful in those classes of cases where the patients are thin and are therefore intolerant of the clasping pressure of ordinary trusses; it is also serviceable in incomplete and direct inguinal herniæ. The umbilical form of truss is often to be recommended in small umbilical and median ventral herniæ.

Coles's truss, like the preceding, has a semicircular spring with a circular pad behind, but to the front is affixed a pyriform convex pad, in the interior of which is concealed a broad spiral steel spring; so that, in addition to the general pressure of the spring, there is the local pressure of the spiral coil in the pad itself, which is increased as the truss is tightened. This form is useful in many cases of hernia, but chiefly in cases of direct inguinal herniæ, and of considerable bulging of the inguinal canal in incomplete hernia.

In *White's moc-main truss* the circular spring is superseded by a leather band. The pad is convex and thick, placed nearly vertically, and lying in a groove on its external surface is a spring and lever, on which is a stud. To this the under strap is attached, the tightening of which increases the pressure of the pad. This form of truss is chiefly of use in direct inguinal herniæ. It is comfortable to the patient, but is not very secure, as it fails to support the inner ring with firm and pliant pressure.

Wood's horse-shoe truss claims the merit of affording support to the canal and the pillars of the outer abdominal ring, without pressure upon the cord as it emerges between its pillars. The front pad, of horse-shoe shape, is made of boxwood, to the geometric centre of which is fixed the front end of the spring. A variety of this truss is provided with a spring and lever, and is stated to be useful in herniæ which are not retained by the simpler form of instrument.

Circular spring trusses are, by some instrument-makers, provided with sliding and with revolving pads, so as to be capable of adjustment to the various lengths and positions of the inguinal and femoral canals in different patients. The efficiency of these forms of trusses is, as a rule, in inverse ratio to the complexity of their mechanical arrangements.

These varieties, which represent the chief mechanical principles on which trusses are constructed, have undergone various modifications with the view either of increasing their efficiency or of lessening their discomfort to the wearers. They are so

numerous, that there are few towns of large size in England which have not given their names to one or other modification of the foregoing varieties of trusses.

JOHN LANGTON.

TUBERCLE has of late been classed among the 'infective granulomata,' a group which also includes syphilis (gumma), lupus, glanders (farcy-buds), leprosy, and actinomycosis, but the degree of its infective force, not yet distinctly formulated, is at all events greatly inferior to that of the other diseases placed in the same class.

Histology.—A tubercle is a non-vascular rounded nodule situated among vascular tissues, from which it generally so varies in colour as to present a clearly definite outline, and varying in size from a barely perceptible point to a lump half an inch or three-quarters of an inch in diameter. It appears under two forms. Miliary or grey tubercles, often also called grey granulations, frequently multiple, rarely exceeding the size of a pin's head, are pearly, semi-translucent globules. The yellow or crude tubercle is produced from the former by a process of fatty degeneration commencing in the centre, while peripheral growth still continuing permits this form to attain the dimensions above mentioned. Larger masses, usually of more irregular form, are due to the coalescence of several smaller ones.

Examined under a power of 200-300, the grey tubercle is found to consist of three zones of cells, supported by a delicate reticulum. The periphery, which is without any definite outside or inside limit, consists of leucocytes or lymphoid elements. These are occasionally supported by a homogeneous or obscurely fibrillated network. Next, is a layer of large pellucid cells of the epithelioid type. The third zone consists of giant-cells usually branched; it is said that these branches are continuous with a fine reticulum, which permeates and supports the cells of the second zone. In some instances, the immediate centre is occupied by an irregularly granulated material, probably the débris of one or more deceased giant-cells. In all this there is, be it observed, no distinctive or specific element; but since the year 1865, when Villemin, followed by Wilson Fox, Cohnheim, Sanderson, and others, produced artificial tuberculosis by inoculation, the possibly infective nature of the disease in the human subject has been suspected. After Pasteur's description of septic and of certain pathogenic micro-organisms, many

attempts were made to discover a like generator of tubercle, but all more or less unsuccessfully until, in 1882, Koch, by using a specially prepared solution of methylene-blue, was enabled to demonstrate the existence, within the giant-cells, of a living organism which he calls *bacillus tuberculosus*. This organism is a rod, generally straight, but sometimes slightly curved, $\frac{1}{7000}$ th of a line (2-6 mm.) long, and in breadth one-fifth or one-sixth of its length—i.e. about $\frac{1}{40000}$ th of a line broad. Its chief habitat is the interior of the giant-cells and the interspaces among the large epithelioid cells of the second zone of tubercles; its movements, if any, are extremely sluggish.

Course and Termination.—Very occasionally, tubercle undergoes a change into an imperfect fibroid tissue, due apparently to an exaggeration of the reticulum; and though, even when thus altered, it generally suffers fatty degeneration, it does sometimes remain as a hard cicatrix-like nodule. Also, in a few instances calcification takes place. But the course of tubercle, so usual as almost to deserve the term normal, is caseation and softening. The latter is commonly called 'breaking down.' When a grey granulation has attained a certain size, the older central parts, which are those farthest removed from nutritive sources, begin to soften into a fatty, irregularly granulated material, which imparts to the hitherto pearly grey nodule a yellowish opaque colour (yellow or crude tubercle). Sometimes, this is preceded or closely accompanied throughout the nodule by caseation; or, after the central parts have thus broken down, the more peripheral portions may become caseous, previous to yielding to the more completely destructive process. The resulting mass is a fatty pultaceous semi-solid.

As these degenerative processes approach or reach the outer zone of the growth, so does the neighbouring tissue inflame. Thus, the healthy or relatively healthy surface next to the mass of disease suppurates, and there is an attempt to throw off the tubercle into a tube or hollow viscus if it have been on a surface, or into a cavity of new-formation if it have been parenchymatous. In the former case a tuberculous ulcer, in the latter a tuberculous abscess or *vomica* results, the floor or the lining membrane of which might be (in a few rare instances is) healthy, but that the softened or caseated tubercle has a great tendency to infiltrate the immediate neighbourhood, or to induce round about

the deposit of fresh tubercular matter, in the form of miliary tubercle, scattered in the tissue surrounding cavities or ulcers of considerable age. Thus, the floor or walls of such excavations very generally consist, in part, of rapidly forming and quickly retrograding tubercular matter, which, continually invading more and more tissue at the circumference and breaking down at the centre, constantly enlarges both the area of tuberculous deposit and of ulcer or abscess. The gravity or the deadly nature of such processes depends chiefly on the locality of its occurrence; but not altogether so, for, when tubercle has gained a habitat in some part of the body, it has a tendency to spread to other portions by means of the lymphatics or the veins, which may carry some of the *materies morbi* from less to more important parts.

Clinically, tuberculosis is divided into acute and chronic; the former is often widely spread—that is, a number of different organs become simultaneously or in very rapid succession infested with tubercles, which, if the patient survive long enough, quickly break down.

Acute general tuberculosis, or tubercles, may attack with almost equal rapidity one organ only, or at least so predominantly that the affection of any other viscus is quite secondary, both in sequence and importance—*acute pulmonary* or *acute hepatic*, or otherwise specified *tuberculosis*.

Occasionally an organ, unessential to life, may be suffering for months from chronic or subacute tuberculosis, when some more important part, as, for instance, the lungs, the cerebral meninges, or the brain itself, may become rapidly involved, death very quickly resulting—*acute secondary invasion or infection of tubercle*.

Local tuberculosis is, as a general rule, chronic. It may affect internal organs, as the lung, liver, brain, kidneys, or it may attack the lymphatic glands primarily, skin (lupus), Peyer's and the solitary intestinal glands, the tonsils, the adenoid tissues at the back of the pharynx, the bladder, prostate, and ureters; also, as is generally believed, the synovial membranes of joints and the bones. (On the tuberculosis of these two latter more will be said in the sequel.) The ovaries, the mammæ, the thyroid, and the muscles (voluntary), are singularly, but not entirely, exempt. Wherever it may arise, tubercle goes through the phases above described, unless its mere presence in some organ of great vital importance excite fatal irritation or inflammation.

Etiology.—The course of tuberculosis, especially as exemplified in phthisis, gave rise many years ago to the opinion that it was in many instances of an infective character. The discovery by Koch of the bacillus tuberculosis, which, after eight generations of pure cultivation, diffused in distilled water and injected into animal tissues, can produce both local and general tuberculosis, has rendered that opinion still more prevalent; while more recent experiments, carried out with all the precautions now known to be necessary, have negatived former results, which seemed to show that indifferent substances, such as glass-beads, setons, &c., introduced into, and left a certain time within the body, resulted in the production of tubercles. Furthermore, animals made to inhale tubercular matter diffused in their atmosphere as spray, develop tubercle, chiefly of the lung. So stringent do these facts appear to many minds, that they consider inevitable the conclusion that tubercle is due to infection by bacillus tuberculosis, and that it can arise in no other way. As, however, in the human subject, entrance of tubercle by inoculation or infection through the skin is unknown, it is by such believers assumed that the tubercle bacillus always finds its entry in man by way of the lungs or of the alimentary canal; in the former case by breathing the same air as phthisical patients, in the latter by eating meat infected by the very common bovine tuberculosis. They point out that such bacillus, if it survive, need not of necessity find its ultimate lodgment at the point it first strikes, but that, taken up by the blood or lymph, it may pass with either circulation to the next most vulnerable point, such as a lymphatic gland, a serous membrane, or some not quite healthy viscus. They furthermore affirm that everyone exposed to the above sources of infection does not of necessity become tuberculous, because the bacillus seems incapable, or capable only with extreme difficulty, of thriving on or in healthy tissues, but that the soil must be to a certain extent prepared by some morbid condition, the chief of which is a low or chronic inflammation, or perhaps that state of ill-nutrition of the tissues which forms the definition of scrofula. See SCROFULA.

But it must also be stated that many pathologists hesitate to accept this theory, being perhaps put somewhat on their guard by its very ease and apparent simplicity, as well as by the fashion of the hour to find bacilli in so many morbid processes. They point to the fact that the diseases known to

be connected with the development of living germs, such as pyæmia, splenic fever, &c., run a course much more acute, and in other ways differing from local tuberculosis; that most tubercles, in parts having no access to the outward air, show a great paucity of bacilli, and in many those organisms are not discoverable at all; that there is much difficulty in accounting for the existence of a bacillus in healthy animal fluids while travelling from the first spot of implantation to, let us say, the cerebral meninges; that the acknowledged necessity for some antecedent morbid process to prepare a *locus vivendi* for the bacillus, into which, by means of such navigation, it may find its way, is not easy to accept; also, that many facts of heredity are not reconcilable with the dogma that tuberculosis can only be produced by reception, from without, of a *contagium vivum*.

The writer thinks it best to place these arguments on either side in juxtaposition, without himself offering any opinion, but, nevertheless, must say a few words on a prevalent tendency to confuse scrofulous with tuberculous inflammation. The two things are distinct. Irritation of teething or of a slight scalp-eruption may produce a lymphadenitis of the neck, which, lasting a long time, becomes evidently scrofulous, but which may subside, or which may become the site of tubercle, but is not, until so infected, tuberculous. So also a joint or a bone may, after some slight injury, assume a scrofulous inflammation. The tissues are rendered no doubt fit for, but may never receive, tubercle, and until they do so the inflammation is strumous, not tuberculous. When they do so the condition is tubercle, not of a bone or of a synovial membrane, but of an inflammatory product. The nodules, named by Rindfleisch 'new lymphatic follicles' (see SCROFULA), have often been mistaken for tubercles. When either the grey granulation or the tubercle bacillus has been found in such a tissue, still nearly healthy or only very recently diseased, and not until then, will primary tuberculosis of those parts be established.

The treatment of tubercle depends in very great part on its situation. Tubercle of the viscera in the three great cavities belongs to the physician. Tubercle of the throat, lymphatic glands, of the prostate and bladder, is described under their respective headings. General directions for treatment can include little but management of a diathesis, and is identical, or nearly so, with that of scrofula, save that residence in sufficiently warm, dry, and above all, equable

climates, is of the highest value. High altitudes are also greatly advocated, and next in efficacy is sea air. Whatever may be believed concerning the bacillus tuberculosis, there is, at all events, sufficient probability in the hypothesis and the alleged discovery, to render imperative that we carefully avoid exposing predisposed persons to the emanations of phthisis or of other tubercular diseases. We may even go further, and sequester such individuals—especially if for family reasons the life be valuable—from any prolonged contact with tuberculous persons.

The possible spread of tubercle from some less important part to a vital organ calls forth the question of early removal, when feasible, of all tuberculous parts. The subject is too recent to be discussed; it can only be suggested here as a surgical problem of the immediate future.

RICHARD BARWELL.

TUBERCULOSIS, Surgical.—Local surgical disease, characterised pathologically by the presence of tubercle in any of its forms, the clinical course of which coincides with the morbid changes known to occur in tubercular deposits.

The subjects of scrofula and tubercle have been treated of under their respective headings; this article is intended to serve as a brief exposition of the views on local tuberculosis which the labours of German pathologists, especially Volkmann and König, have done so much to generalise. A lengthened general introduction to the local affections treated of below would therefore be superfluous, but it is necessary to make a few remarks on the connection of surgical tuberculosis with scrofula, the etiological importance of trauma and inflammation, and the relation of local to general tuberculosis.

Volkmann suggests that the tubercular nature of an affection is indubitable when (1) inoculation gives positive results, (2) the bacillus tuberculosis is demonstrable, and (3) the tissues exhibit the typical structure. These three confirmatory conditions are, however, not to be looked for in every case, since inoculation sometimes fails from accident, or incapacity for infection of the animal chosen; (2) the bacilli are in some cases, in chronic ones especially, very limited in number; and (3) in some acutely progressing cases the structure is not characteristic, although the bacilli may be abundant. Under these circumstances, two of the conditions should suffice, especial prominence being given to the inoculation test.

All recent investigations tend to support the infectious nature of tubercular processes, and, moreover, to strengthen the dependence of this property on the bacillus of Koch. Considering the wide distribution of the infecting organism, it is necessary to endeavour to gain some notion of the reason why some of those exposed to infection suffer from tubercular diseases while others go free. In the present state of knowledge, this is explicable only on the supposition that healthy vital tissue is an unfit nidus for the development of the virus. Some change must occur before the organism can develop itself, and induce the characteristic process and appearances due to its presence. The condition most favourable to this development is a local or general depression of the vital processes, leading to inflammatory changes, and it is here that the connecting link between scrofula and tubercle has been sought. The scrofulous diathesis has been said to consist in a tendency to processes, essentially of an inflammatory type, marked by the characteristics of chronicity, a tendency to the development of granulation-tissue and to caseation. Thus, under the head of scrofula are described characteristics both of a general diathesis and of local affections. Attempts have been made to explain the peculiarities of the inflammations occurring by special structural arrangements, which find mention in the article on SCROFULA.

When we endeavour, however, to separate the local processes due to scrofula and tuberculosis respectively, we find ourselves landed amongst innumerable difficulties. Most pathologists will, no doubt, admit that the majority of such processes belong to the province of tubercle; indeed, in some organs—notably the testis—the name tubercular testis is rapidly superseding, if it has not already altogether done so, that of scrofulous testis. Again, in the case of so-called scrofulous glands, authors (Allbutt and Teale) who do not call them tubercular, allow their capacity to produce tubercular disease on inoculation. The writer thinks it will not be long before this change in terminology occurs in most other so-called scrofulous diseases. Are we then to regard scrofulous and tubercular diseases as identical? Here we are met by the difficulty, well put by Volkmann, that a healthy blooming individual may present all the general characteristics of the scrofulous diathesis, but no local affection as evidence of tubercle. It would seem best, then, to restrict the term scrofulous as indicating a diathesis characterised by the personal

peculiarities described in the article on SCROFULA, and, while not denying the possibility of simple inflammations in scrofulous subjects, to refer all those inflammations which have been described, as undergoing the changes already mentioned—changes ordinarily occurring in tubercle—to the category of tuberculosis.

Traumatism, as a causative agency, finds an explanation in the induction of a precedent inflammation. The slowness of the violence exerted, often noted, is perhaps of importance as not occasioning a very acute process, a condition unsuited to the development of the organism (Volkmann). Allied to trauma as a cause, is overuse of a part, as exemplified in tubercular disease of a joint, freely used from its position and the occupation of the patient—e.g. elbow in a mason. The ultimate tubercular nature of many joint cases, commencing during the course of an acute exanthem, may perhaps be similarly explained; the inflammatory infiltration offering a suitable nidus or *locus minoris resistentiæ*.

Another point of extreme importance, from a prognostic point of view, is the possibility of these local affections acting as infecting centres for the production of a general tuberculosis. The mode by which the primary infection occurs, as far as our knowledge will allow us to presume, is commonly from the alimentary or respiratory tracts, possibly, in rare cases, from a broken cutaneous surface. A primary infection having taken place, the modes of extension or generalisation may be shortly enumerated, as a consideration of these gives some indications as to surgical treatment, and also explains the comparatively good prognosis in cases of external tuberculosis. They are—

1. By wide extension of the original deposit in the surrounding tissue, or direct extension along mucous or serous surfaces.

2. By extension through the lymphatic system, such extension being usually limited by the lymphatic glands. If the tuberculosis spread beyond these it may reach the thoracic duct (Ponfick), and so the virus may be poured directly into the general circulation. Volkmann remarks that the function of the lymphatic glands as stop-gates, or even possibly destroyers of the poison, has not yet been sufficiently recognised.

3. Infection of a serous sac, either by direct extension, or by rupture of a neighbouring suppurating or caseating deposit. The danger in the latter case depends on the size of the sac, its lymphatic connec-

tions, and possible lining with granulations, —forming a barrier against further diffusion.

4. The entrance of tubercular matter into canals or cavities lined with mucous membrane, where stagnation is possible or actual length renders long contact inevitable.

5. Entrance of tubercular matter into veins by extension, or rupture of neighbouring deposits (Weigert); or by septic changes in tubercular wounds, leading to breaking down and distribution of the venous thrombi (König).

Consideration of these modes of extension explains the comparatively favourable position of a patient suffering from tuberculosis of the skin, bones, joints, or glands; for, in addition to the fact that the affected organs are less important in the vital economy, the danger of generalisation from them is manifestly less than in tuberculosis of the respiratory, alimentary, or genito-urinary tracts. As to the frequency with which general or secondary infection occurs, it is difficult to speak with certainty; but in relation to this subject, a point much insisted on by Volkmann is of great importance—viz. that in many cases the primary deposits are multiple, although only one causes appreciable symptoms. A familiar instance in support of this is the multiple nature of the lesions in tubercular dactylitis. That a large number of cases die of tubercular phthisis was long ago pointed out by Billroth, and has since been confirmed by many authorities, but it is not possible to give any reliable percentage of cases in which the pulmonary disease was evidently secondary. A certain number of cases, particularly of tuberculosis of joints, die of acute general tuberculosis; but here a point emphasized by König must be regarded with attention—namely, that in all the instances in which this occurred among his cases, the patient had been recently operated on, and the wound had become septic. The writer has seen similar cases. These considerations, therefore, would seem opposed to the theory of removing a local infecting centre as a general rule, except in such a case as the testis, where removal may prevent direct extension, by continuity of surface, through so important a tract as the genito-urinary.

As has been already pointed out, the danger of general infection is not great, and when the disease is limited to external parts, the interference with the vital functions is not sufficient to make the outlook a correspondingly bad one to that in cases where internal organs are affected. The

local prognosis is of more importance; and here it may be broadly stated that complete removal ensures local cure, but the possible presence of other deposits may prevent the cure from being complete. A number of secondary considerations will affect the question—as the surroundings of the patient, the extent of the disease, and the general condition; the nature of the process as to its tendency to granulation, caseation, or suppuration; the age—youth, as in other diseases, being on the patient's side, and markedly so both in the possibility of spontaneous cure, less rapid destruction, and in the relative infrequency of concomitant pulmonary phthisis. Lastly, as to spontaneous cure: under favourable circumstances this is always possible, but, as in all other diseases of a similar nature, recurrences may readily take place from fresh activity of the process in and around the latent deposit.

TUBERCULAR DISEASE OF BONE.—The deposit of tubercle in bone may form a part of an acute general miliary tuberculosis, or it may be a distinct local affection. In the latter case it may of course serve as an infecting centre, but more commonly its prejudicial consequences are the result of direct extension.

Miliary tuberculosis of bone, as a part of an acute general condition, may be dismissed with mere mention, since it is uncommon and devoid of clinical interest. Recognition of the frequency of local tuberculosis amongst chronic bone-affections is, however, perhaps the most important result of recent investigation of tubercle from a surgical standpoint. The disease is characterised by definite appearances, situation, and course of extension, which allow a fixed boundary to be placed between it and other forms of bone-affection, such as acute infectious osteomyelitis, simple chronic inflammations, or those due to syphilis. Subsequent description will, however, identify the affection more or less completely with that often spoken of as scrofulous.

Situation.—No bones or parts of bones are exempt from the possibility of tubercular disease, but the special seat of predilection is the cancellous structure of the articular ends of the long bones and of the short bones. Deposits are common in the bodies of the vertebræ, the os calcis, the olecranon, the condyles of the humerus, and the neck and internal condyle of the femur. Observation tends to free the head of the tibia from the unenviable distinction of being the head-quarters of this disease. The shafts of the long bones and the flat

bones may be affected, the most typical examples of the former occurrence being met with in tubercular dactylitis; while deposits are common in the acetabulum, and far from rare in the glenoid cavity of the scapula and the skull.

Appearances.—The morbid processes vary according to the structure of the bone affected, and will be considered here first as they are met with in cancellous, then in compact bone.

Localised Tubercular Ostitis.—In cancellous bone the disease commences as an ostitis affecting limited areas, which may vary in extent from the dimensions of a pea to that of a hazel-nut. The deposits may be single or multiple; in the latter case two or more may coalesce by extension. The process is primarily rarefying in character, the bony trabeculae being thinned by absorption of the walls of the Haversian canals, soft granulation-tissue, containing histologically perfect reticular tubercle, taking the place of the harder element. The ultimate termination may vary considerably: the bone-tissue may be converted into a mass of granulations without suppuration (caries sicca); the process may proceed irregularly, small islets of bone being cut off and necrosing (caries necrotica); a sequestrum of some size may be formed, or caseation or suppuration may occur. In the case of the caries assuming the dry form, secondary ossification and sclerosis may occur; if caseation or suppuration supervene, the area may become encapsuled by a layer of sclerosed bone.

In the majority of cases progressive changes occur, the tendency being to extend peripherally—in the joint ends preferably towards the articular cavity—the cartilage being undermined and perforated by the granulations. Perforation may, however, take place beyond the articular margin, in rare and favourable cases even beyond the attachment of the joint-capsule. The two latter occurrences are the less frequent, from the fact that extension towards the compact tissue is usually accompanied by subperiosteal bone-formation, which renders perforation a slower and more difficult process. They are of radical importance with regard to the possible implication of the joint, and the limited or diffuse nature of the local joint-affection. This subperiosteal bone-formation accounts for the actual enlargement of the bone-ends occasionally met with. Prior to perforation, and even when that has occurred, a satisfactory view of the affected area can

only be obtained by section of the bone-end. The appearance will then vary according to the special form the process has assumed.

Circular defects or burrowing tracks may be met with, either single or multiple; in the case of dry caries, often the latter; these may be situated near the centre or peripherally. In recent cases they may consist of soft grey or reddish-grey granulation-tissue, often with evident tubercles at the periphery, and surrounded by an area of hyperæmic bone. If caseation has occurred, the tint will be yellower, and, when the granulations have been cleared out, in recent cases the walls will be softened, in old cases more or less sclerosed. In all cases, molecules of bone exist in the granulations; in caries necrotica, palpable sequestra are present; in other instances, the whole of the centre of the area originally affected forms a sequestrum permeated with tubercular granulations, and lying in a cavity lined with similar tissue more or less firmly connected thereby to the sclerosed wall or surrounding bone. In other cases the cavity will contain broken-down caseous material and pus. If the process has extended directly down to the cartilage, the latter will be more or less extensively detached, perhaps perforated; if perforation has occurred beyond an articular margin, more or less irregular disposed periosteal bone will surround it. In rare cases, the bone may be secondarily affected by extension of the tubercular process from the soft parts, as seen in cases of lupus of the face extending down to the bones. Where the affection of the bone is recent, tubercles may be found deposited in the marrow of the cancelli, without any change in the trabeculae (Volkmann).

Besides the forms of necrosis already adverted to, a third occurs. Here, a considerable area necroses as a result of a somewhat more acute tubercular infiltration. This may occur in the pelvis, ribs, skull, or notably in the articular ends. When met with in the articular ends, the sequestra are often of a typical wedge shape (suggesting to König a possible embolic origin, the whole area becoming infected by bacilli spreading from the original embolus into the arterioles), of a yellow colour, permeated by tubercular granulations, and separated from the surrounding healthy bone by a layer of tubercular granulations to which they are attached, and which preserve the bone from wider affection. In the skull and pelvis they are irregular in outline; in the case of the former, the sequestra are

similar in character, but are peculiar in affecting both tables of the skull to an equal extent.

Diffuse Tubercular Osteomyelitis.—This is a much less common and more serious disease than that above described. The tubercular infiltration may affect the whole medullary cavity. It usually commences at a cancellous end, but, deviating from the common course, extends centrally. The medullary cavity becomes filled with soft, breaking-down, tubercular granulations; the compact tissue is much thinned. Local prognosis in these cases is very bad.

Tuberculosis of the Shafts of the Long Bones.—This affection, implicating the compact tissue from the first, is less common than the form first described. The disease is commonest in the metacarpal and metatarsal bones and their phalanges; more rarely it occurs in the femur and tibia. It is a disease of childhood, characterised by chronic enlargement of the bones, due to the following process. Deposition of tubercle takes place both in the medullary cavity and periosteum; this leads to the development of granulation-tissue in the canal, and of irregular spongy nodes containing tubercle beneath the periosteum. The true compact tissue is gradually thinned, while, later, a layer of hard bone is sometimes developed beneath the periosteum on the surface of the osteophytic nodes. The process sometimes subsides spontaneously, and subsequent absorption of the new bone removes all trace of its occurrence; more commonly, however, considerable shortening remains from arrest of growth.

Effects of Bone-Tuberculosis.—The extreme importance of the process is derived from the formidable nature of the complications due to extension. Here we find the origin of an overwhelming percentage of the cases of joint-tuberculosis; while bones bordering on the large cavities may, when so affected, lead, by extension of the process, to meningitis, pleurisy, or peritonitis, with all the attendant dangers of infecting a large lymphatic sac. No more fertile source exists of cold abscesses, especially in their most formidable form—the spinal abscesses; and, lastly, no disease of bone so commonly leads to lasting deformity from loss of substance, as is met with in spinal caries and pathological displacements of joints.

Signs of Tubercular Disease of Bone. These are chronic in nature, often most insidious; in many cases the first sign met

with is due to some complication. An important early symptom is pain, which may be characterised by the deep boring character and nocturnal exacerbation common in central bone-cases, but this may be absent. Later, local thickening and tenderness, followed by œdema, redness, and suppuration, may occur; the suppuration may sometimes be superficial, but is generally in direct communication with the osseous deposit. When the suppuration has pointed, a chronic fistula is usually established, lined with tubercular granulations, discharging thin unhealthy pus. On probing, the sensation will vary with the form of caries present; the commonest result is to feel the bone covered with granulations, and often small sequestra, giving a gritty feeling, may be embedded in these. Such fistulae are extremely chronic, and rarely heal without treatment.

In many cases, however, where the joint-ends are affected, joint-symptoms, as local tenderness or pain on some particular movement, with more or less effusion, are often the first signs; such synovitis at an early stage is often simple, thus differing widely from that met with when perforation has occurred, and when a well-marked joint-tuberculosis is the result. In disease of the vertebral bodies, neuralgic pain, deformity, or abscess may be the first sign, and abscess or neuralgia may be the first signs of pelvic disease. Tubercular necrosis of the vault of the skull is most common in the frontal and parietal bones; it may be heralded by cerebral symptoms from pressure due to inflammatory effusion within the skull; in other cases a large, lax, cold abscess forms. Necrosis of a rib, again, is often first evidenced by abscess or empyema. In the case of the long bones, increased epiphysial growth may result from the abnormal vascularity, or, later, dislocations may occur from actual loss of substance.

In tubercular dactylitis, a chronic fusiform enlargement of a metacarpal or metatarsal bone or phalanx may take place, often without pain. Several bones are often implicated. The disease may, after a time, recede, leaving slight evidence of its occurrence, but, usually, arrest of growth leaves permanent shortening in cases of recovery. If it progress, the skin and surrounding tendon-sheaths become implicated, reddening occurs and suppuration; the disease often leads to spontaneous fracture. A marked characteristic is the limitation of the disease to the diaphysis. Its occurrence is limited to childhood.

Diagnosis.—The presence of tubercle in other organs, a tubercular history, or the special personal characters are often of value. The less acute nature of the process, and its tendency to spread in the direction of the epiphysis (dactylitis excepted), contrast strongly with the extremely acute invasion and tendency to spread in the diaphysis, characterising acute osteomyelitis. In the later stages, the different character of the sequestrum, its yellow colour and permeation with granulations, contrast quite as markedly with the hard white sequestrum of osteomyelitis. In the case of more chronic simple ostitis or caries the diagnosis is more difficult, and must depend on the general aspects of the case and a microscopical examination. The history, and the result of treatment, should settle the question of syphilis in any given case; but difficulty may arise in some cases of dactylitis and necrosis—in the latter, the tendency to sclerosis in syphilitic affections should be borne in mind.

Prognosis.—This depends greatly on the situation of the disease, and the direction in which extension may have taken place, greatly also on the dry or suppurating character of the original deposit, which will impress a corresponding character on any further processes it may give rise to by extension. Local cure may follow complete removal, or may occur spontaneously; in the latter case, usually leaving some permanent deformity (angular curvature, shortening, &c.). In no case, however, where spontaneous cure is supposed to have occurred, is the patient free from danger of subsequent recurrence from the lighting up of a fresh inflammation at the latent spot.

Treatment.—The general treatment differs in no way from that followed in other cases of tuberculosis. As to local treatment, the first indication is rest, and, where extremely chronic symptoms exist, counter-irritation may be of use. The first indication is usually fulfilled by the use of splints; for the second, blisters or, rarely, the actual cautery may be applied.

When signs of progressive disease exist in the neighbourhood of a joint, no time should be lost in trephining or chiselling the bone, so as to afford a free exit, and divert the course of extension from the direction of the joint. Any cavity thus opened should be freely scraped out with a sharp spoon, or the wall chiselled away, and the cavity may be dressed with iodoform. Where a sequestrum exists it should be removed, and the walls of the cavity treated in like manner. The question of excision and

amputation are treated of in the next section on joints.

TUBERCULAR DISEASE OF JOINTS.—These affections are broadly divided into two classes: 1. Where articular disease is secondary to tubercular ostitis of the joint-ends. 2. Where primary tuberculosis of the synovial membrane occurs.

1. *Arthritis secondary to Tubercular Ostitis.*—This may depend on extension of any of the forms of bone-disease above described, the nature of the primary process impressing itself on the secondary joint-mischief. If the primary disease is of the dry or fungous form, or if one of the wedge-shaped sequestra is present, suppuration does not necessarily occur; if, on the other hand, caseation or suppuration of the primary deposit has taken place, a local or general suppuration of the joint-cavity is the invariable consequence. The perforation leading to infection of the articular cavity may, as already mentioned, take place either through the articular cartilage or through the bone beyond its margin, but internal to the line of attachment of the ligaments. This point of infection is of considerable importance, since, if it be beyond the margin of the articular cartilage, inflammation of the periosteum and structures in immediate contact with it may have led to adhesions, so disposed as to ensure the general joint-cavity from infection. If, on the other hand, the perforation be subchondral, a general infection of the articular cavity is the result. The possibility of such a local infection must always be taken into consideration in examining the tissues for tubercle, for it may exist here alone and in very limited extent, although considerable inflammatory change may have occurred in the synovial membrane generally. The bone-deposits may be single or multiple, confined to one bone, or affecting both bones entering into articulation. The appearance of these deposits has been already described under the heading of *Tubercle in Bone*; it will be only necessary to describe here the condition of the remaining joint-structures.

The cartilages are always secondarily affected, playing a passive part. In cases where perforation is subchondral an opening may exist, the edges of which are bevelled off from the osseous aspect to a thin margin, or the whole sheet of cartilage may be separated, hanging in shreds, or readily tearing off the subjacent granulations. When perforation has occurred beyond the margin of the cartilage, the latter may still be loosened, as the result

of a subarticular osteitis or caries; in other cases it is absorbed from its free surface by the granulating synovial membrane. In the latter case, it may retain its attachment until total absorption occurs by a process of gradual thinning. In examining the subchondral osseous granulations in such cases, especially the latter variety, it will be found that they are very frequently simple in nature, the tubercular process being limited to the original deposit and the immediate neighbourhood of its perforation.

The synovial membrane is thickened, in the more chronic cases enormously so, both by the development of a species of false membrane on its surface and by infiltration of its deeper layers; it is of a greyish or brownish-grey tint, studded thickly with lighter-coloured spots, softened and pulpy in consistence. On examination, it is found to contain enormous numbers of typical reticular tubercles and long areas or stretches of tubercular tissue, suggesting to König the idea of invasion of the lymphatic spaces; in addition, numerous isolated giant cells are met with, dispersed through the small-celled infiltration. In old cases, a similar infiltration may have invaded the ligaments, though for the most part the infiltration in these is of a simple inflammatory nature; this latter usually extends into the pararticular structures, binding down the skin and destroying its normal mobility. The subsequent contraction of this pararticular infiltration causes the white anæmic condition of skin which led to the adoption of the name of white swelling. The infiltration and softening of the ligaments allows the occurrence of spontaneous dislocation. The joint-cavity may be more or less obliterated or cut up into sections by adhesions, or it may contain a varying amount of thin cheesy pus. Such pus may come to the surface and point externally; in other cases, abscesses form in a localised cavity or on the external surface of the joint-capsule. These pararticular abscesses are usually the result of caseation and suppuration in the infiltration of the soft parts above described; in rare cases, they may result from the perforation of tubercular deposits in the articular ends, beyond the attachment of the ligaments.

In other cases where, as already mentioned, the process of infection has been limited by prior adhesions, the tubercular changes may be limited to a small area, while the other changes in the joint are of a simple nature; and, where the course is chronic, these may be entirely atrophic in

character, so that, in place of the large fusiform pulpy joint, a thin skeleton-like joint may be present, the atrophy of the soft structures leading to the idea that the bone-ends are considerably enlarged. Actual localised enlargement may exist when periosteal new bone-formation has occurred. In old suppurating cases, again, a very considerable new bone-formation may exist, generally within the joint-capsule. The muscles of the limbs undergo fatty degeneration and atrophy from disuse; this may sometimes be masked by the existence of extensive tracts of suppuration in the deep planes of the limb. Pathological dislocations of the joints are common, either from shortening and malformation due to absorption; from separation of portions of bone, as in the case of the head of the femur where the neck is implicated or a part of the acetabulum is necrosed; or by the pushing out of the head of a bone from a joint-cavity by redundant granulations, as may occur in the case of the femur and acetabulum.

2. Primary Synovial Tuberculosis.—

This may take on several forms; the affection of the synovial membrane may be local or general, and the tendency may be to serous or suppurative inflammation.

In its severest form, we have the most typical example of white swelling, and the appearances do not in any way differ from those described in the last section, except in the absence of osseous deposits, and the fact that the tuberculosis of the joint is usually general.

In the serous forms, less thickening of the synovial and subsynovial tissues occur, and the disease is characterised by considerable distension of the joint, the fluid being clear or containing flakes of lymph or melon-seed bodies. In these cases the membrane may be studded with very numerous tubercles. In the late stages, the thickening may increase and become considerable.

Lastly, a nodular form (König, Riedel), is sometimes met with. It is rare, commonest in the knee. This variety is characterised, in some cases, by the development of a single tubercular tumour in the fibrous layer of the synovial membrane, which may reach the size of a pigeon's egg; in other cases the individual tumours are smaller, and may be numerous. The tubercles lie in the fibrous layer of the membrane, surrounded by small-celled growth and young connective tissue, the nodules are of a pinkish-grey colour, speckled with points, or a pure grey colour, and the normal

synovial epithelium covers them. The joint usually contains fluid in considerable quantity, often melon-seed bodies.

The relative frequency of primary osseous or synovial cases is difficult to determine accurately, but all authors agree in regarding the bone cases as largely preponderating. The proportion varies in different joints and at different ages, synovial cases being relatively more frequent in childhood. König gives the following percentages. All joints—synovial cases, 20 per cent.; hip—synovial cases, 6 per cent.; knee, 33 per cent.; elbow, 20 per cent. He also gives the following statistics as to the influence of age in the cases observed in his *Klinik*:—

3-14 . .	Bone cases, 50 . . .	Synovial, 21
14-30 . .	" " 64 . . .	" 18
30 & over	" " 39 . . .	" 12

Symptoms.—The local signs will vary according to which of the pathological varieties exists, and they will be so described; but it must be at the same time stated that the different forms may, in their different stages, so much resemble each other that it is often impossible to decide whether the case be primarily a bone or synovial one, without an opportunity be afforded by operation for internal examination.

Primary Bone Cases.—The early symptoms are often extremely insidious. Local pain may exist, and, later, tenderness on pressure or on some particular movements, indicated by limping or interference with free movement of the joint. Local thickening of the bone may be present, or effusion into the joint (as already mentioned, possibly simple) may occur. This effusion may become absorbed with rest, and later will reappear, often with acute local and constitutional signs, indicative of suppuration and infection of the joint. In cases where no adhesions exist, this infection leads to general thickening and pulpy degeneration, with the development of a typical fusiform white swelling. In cases where adhesions exist, a local abscess only may form, with atrophic changes around. Where the original bone-mischief is of the dry or fungating form, suppuration may never occur, the disease being characterised at first by moderate swelling and loss of function, later by deformity due to absorption of bone-ends subsequent to their conversion into granulation-tissue, and extreme wasting of the muscles surrounding the joint. The most typical examples of this disease occur in the hip and shoulder.

Primary Synovial Cases.—Here we have the typical white swelling. The disease usually commences insidiously, at other times with an effusion following a slight trauma. In the case of a joint in the extremities, the typical fusiform swelling now develops, being emphasised by the wasting of the limb above and below the joint. The swelling is doughy and pulpy to the touch, completely effacing all the natural prominences and depressions around the joint; the limb takes up the position characteristic to the joint affected, considerable abnormal mobility from stretching and softening of the ligaments develops, while the normal movements are limited by intra-articular adhesions and the infiltration around the joint. As the cartilages become affected, muscular rigidity prevents passive movement, and the usual night-startings occur. The changes may progress slowly, contraction of the pararticular infiltration giving the skin a white and anæmic look. Abscesses may form in or on the surface of the joint; these are sometimes small and acute, oftener of considerable extent, and of the typical cold variety. It is difficult sometimes to discover any connection between them and the joint. In the later stages these abscesses open, often after burrowing considerably, and long fistulæ, lined with tubercular granulations, remain in connection with a deformed articulation. Such cases may go on for years, at times improving, then relapsing, until finally the last stage is reached. The lymphatic glands above the joints are often enlarged and tubercular, this change being more common in the upper than the lower extremity (Volkmann).

Cases of tubercular hydrops are characterised by the insidious invasion of the effusion, and later by the chronic nature of the thickening of the synovial membrane which persists. The cases of local tumour or nodular thickening are also usually accompanied by considerable effusions. Cases of hydrops may terminate in typical white swellings.

Diagnosis from other joint-affections will be made by the presence of the characteristic diathesis, possibly by signs of tuberculosis in other organs, and by the special course of the case and its pathological peculiarities. The question of primary bone or synovial affection must be made on the lines indicated in the description of the symptoms. The occurrence of local tubercular tumours is to be borne in mind in cases of tumour of the great sac of the knee-joint.

Prognosis.—The general prognosis will depend on the presence of contemporary tubercular disease elsewhere, the general condition of the patient, his surroundings, and his age, becoming proportionately worse with increase in years.

The local prognosis varies with the joint affected, as to its size, accessibility, the possibility of removing the morbid tissue completely, and the nature of the process as to suppuration. The prognosis is best in dry caries, when the joint may heal spontaneously without suppuration. Where moderate localised bone-mischief exists, capable of complete removal, and probably accompanied by limited affection of the joint only, the prognosis is much better than in extensive synovial disease, where complete extirpation of the tubercular tissue is difficult or impossible. Extensive abscesses are bad, and the presence of a sequestrum is also bad prognostically, as necessitating suppuration or opening of the joint. As to the result after spontaneous cure or after operation, in all cases the mobility will be seriously interfered with; in many, complete fibrous ankylosis takes place, and in spontaneous cures considerable deformity is the rule. In all cases, however favourable their course, the possibility of a relighting up of the mischief at the seat of the old deposit is always to be remembered.

Treatment.—The treatment of tubercular joints, in its main principles, differs little from that of other joint-affections, but several points of detail are of extreme importance, and will be shortly adverted to.

The general treatment differs in no particular from that of other tuberculous affections; the special point in the local management is to ensure perfect rest to the articulation, while the patient is confined as little as possible. Rest is, as a rule, best ensured by the application of plaster of Paris splints, except in the case of the hip, where Thomas's splint is more convenient and comfortable. It should be continued for some time after the apparent subsidence of the joint-mischief; interference with mobility must be put up with. In no case should any very active efforts be made to restore free movement, as free manipulations are commonly followed by inflammation and possible relighting up of the tubercular process. This rule especially holds good in the later stages of the disease, even if it has been quiescent for some time; if considerable deformity exist, it is preferable to perform osteotomy of the shaft of the bone in the neighbourhood than

to interfere with the joint itself. Thus, contractions of the hip, not amenable to gradual extension or moderate manipulation and, possibly, tenotomy, should be treated by subtrochanteric division of the femur, those of the knee by division of the femur above the condyles.

Counter-irritation, except in the form of iodine paint, is rarely to be made use of. Treatment by rest is especially successful in cases of dry caries, and here, as in cases of synovial disease, the greatest care should be exercised to maintain it, as thereby suppuration is most certainly prevented.

In the majority of cases, however, rest fails to fulfil its object, and here further treatment is necessary, and the relative merits of arthrectomy, excision, and amputation come under consideration. The question of excision or amputation has been considered in the general articles on these subjects, and needs no lengthened mention here; the only special point, that of removing a local infecting centre by amputation, has been alluded to in the general section of this article. The facts there detailed are opposed to the practice.

A few remarks must be made on the special application of arthrectomy and excision.

The main points to be noted in excising tubercular joints are: 1st. The necessity of completely excising the infected synovial tissue, since, if any portion of this or infected granulations remain, the wound becomes re-infected, and the prospect of cure is little better than before the operation. To do this effectively, the incisions must be free, and the scissors are preferable to the sharp spoon, as rather more than the actual granulation-tissue is thus removed. 2nd. To examine the bones with extreme care so as to discover, if possible, the original deposit, and thoroughly to extirpate it by means of the gouge or chisel. As to the employment of excision, it may be said to be applicable only to the hip-joint, and perhaps the elbow, before fourteen years of age; later, it may be performed under the same rules as in other forms of disease.

Below fourteen years of age, except in the hip, and in many cases over, arthrectomy is generally to be preferred. The advantages claimed for the procedure are the following:—No bone being removed, no loss of length follows; the epiphysis not being interfered with, growth is not arrested; the joint in some cases, as the knee, retains its normal outline; it may be employed in some cases where from extent of disease

excision is impossible, and amputation formidable from the amount of limb which must be removed; and lastly, it allows the possibility of a secondary excision or amputation if it should be deemed necessary. In arthrectomy, as in excision, too great pains cannot be taken to completely extirpate the infected tissues, and on the completeness of this the final result mainly depends.

It is usually followed by fibrous ankylosis in varying degrees of completeness. In the after-treatment, it must be borne in mind that deformity occurs as readily as after excision, if a sharp eye be not kept upon the patient. The best dressing, after either excision or arthrectomy, is iodoform. In many cases, either operation is often followed by the persistence of sinuses from reinfection of the wound, most probably due to incomplete removal; such patients may be fit subjects for amputation, or may succumb to some other form of tuberculosis or to amyloid disease.

A more troublesome form of disease to treat is perhaps the so-called hydrops tuberculosis. This disease is not so generally recognised in this country as on the Continent, where the active treatment employed has allowed the surgeon special opportunities of examining these joints at a much earlier date than they come under notice here. In addition to rest and pressure, the first active local measure will be to tap the joint, with a view to relieving tension, preventing injurious stretching of the ligaments, and also obtaining more exact information as to the condition of the synovial membrane. This having been done, considerable difference of opinion exists as to further operative measures. The plan usually followed is to continue the local treatment by rest and support, but Continental surgeons consider that when a diagnosis is established, more active measures are needed. König incises the joint freely, extirpates the infected synovial membrane accessible from the openings, and actively rubs in iodoform to any part of it which cannot be got at with the knife. Volkmann makes such incisions as to allow complete extirpation of the membrane. The partial operation has met with some success in the hands of König; but, as it seems in great measure to depend on the local action of iodoform on the diseased structures left, the writer would suggest in such cases to try the effect of injecting an emulsion of iodoform and glycerine, similar to that used by Mikulicz for spinal abscesses. The mixture con-

sists of glycerine with 10 per cent. of crystallised iodoform shaken up in it. About fʒj. of such a mixture might be safely injected into a joint, since Billroth has injected as much as 100 grammes (containing 150 grains of iodoform) into a spinal abscess without bad result. The mixture must be well diffused by pressure. The success of this treatment in tubercular abscesses, in the hands of Billroth and Mikulicz, would seem to offer a fair probability of good results in joints where the disease is general and no adhesions exist.

The local tubercular tumours have also been removed by incision; this would seem the right treatment, as otherwise the whole joint may become affected by extension.

TUBERCULOSIS OF TENDON SHEATHS AND BURSAE.—Tuberculosis of the sheaths of the tendons may be primary; in the majority of cases it is secondary to disease of the bones or joints. When secondary, it is diffuse, the sheath being lined with fungous granulations, and sooner or later containing pus. When primary, the same condition may exist; in other cases, the deposits are localised in a similar manner to that noticed in the nodular form of tubercular synovitis.

Signs.—An elongated pulpy swelling in the line of a tendon, most commonly met with in the foot, and as a primary condition in connection with the tendo Achillis. At a later date suppuration occurs, and, if not incised, spontaneous opening takes place, with the development of chronic fungating fistulae. The process may, when the tendon is in the immediate neighbourhood of a joint, affect the articulation by direct extension. More or less widespread local extension is common.

A similar condition may, rarely, affect the bursa; in other cases, a bursal hydrops, similar in its pathological condition to the joint-hydrops, occurs.

The *prognosis* is not good. Such cases are extremely difficult to heal, and the danger of extension is considerable.

The *treatment* is as complete extirpation as possible with the scissors, and iodoform dressing.

TUBERCULOSIS OF WOUNDS.—Considering the ease with which an acute tuberculosis is produced in animals by inoculation, it seems strange that examples of a similar nature have not been observed in man. Infection, due to cohabitation with a tuberculous person, has been commonly suspected and seen to occur, and although often complicated by the question of occurrence in persons of the same heredity,

taken with similar observations made on animals it is of extreme importance. Evidence of direct inoculation and transference of tuberculosis in man has, however, only been offered during the past few months. The source of such cases would naturally be sought by surgeons among external wounds, and although it has been suggested that infection of internal organs has followed affections of the skin, possibly primarily tubercular in nature, in no case has any proof of the fact been furnished. Secondary tuberculosis of wounds, from extension of existing deposits in continuity with them, is of every-day occurrence; but this never appears to occur if the diseased tissue be wholly removed at the time the wound is made. That this is the case, is rendered the more probable from the fact that none of the chief workers on this subject have ever noted tubercular changes in an amputation wound, when the operation to remove the diseased structures was undoubtedly carried through healthy tissues. This is the more anomalous, since, as a *locus minoris resistentiæ* in a tubercular patient, one would expect to see, at any rate in some cases, the wound take on a tubercular character. During the past year, however, a small number of cases has been published by various observers in Germany bearing on this question. Three (König 1, Kraske 2), are examples of tuberculosis of osteotomy-wounds in young patients, ostensibly in sound health, who were exposed to the possibility of infection by residence with phthisical patients. These cases, however, though of interest, are not convincing, since the two reported by Kraske were osteotomies for deformity, resulting from ostensible osteomyelitis, and, distinct as the signs may have been, considering possible error in diagnosis, they can only be regarded as possibilities. König himself, while putting the third case on record, thinks it of interest rather than as a proof.

Two other observations (Karg, Riehl), have been obtained from another source, one which would have been regarded as likely to offer some valuable information—viz. the hands of those employed in making post-mortem examinations on tubercular subjects. Both patients had so-called post-mortem or butcher's tubercle on the hands and, secondary to this, affection of the lymphatics of the arm. The diagnosis was founded on the histological structure and the presence of bacilli. In neither case is any mention made of inoculation experiments, but, in one, cultivation

failed. A third observation (Tscherning) was made in the case of an attendant on a phthisical patient, who wounded her finger, the wound showing signs of tubercular infection spreading to the tendon-sheath and the lymphatics. Examination of the structures again allowed the diagnosis to be made from the structure and presence of bacilli, even in the axillary glands. These cases can of course only be regarded as an elementary contribution to the question; but the importance of the subject warrants their mention. The one striking feature is the local nature of the infection, standing in sharp contrast to the general tuberculosis observed in animals under similar circumstances.

TUBERCULAR ULCERATION.—Closely allied to the above subject are those of tuberculosis of the skin and mucous membranes. For some time, the superficial eczema and skin-inflammations observed in so-called strumous children have been regarded as specific in character, while the nature of the process set up in lymphatic glands secondarily affected has led to the supposition that they may be tubercular. The question has become included in the range of practical pathology by the discovery of tubercle bacilli in such a case (Volkman). The tubercular nature of lupus has long been a contested point; but strong affirmative evidence has lately been adduced in the positive results of inoculation experiments, the discovery of bacilli, the local structure, the co-existence of tubercular disease of other organs, and the cases of general tuberculosis occurring secondarily to it lately recorded by Besnier, Doutrelepon, and Leloir. The observation of Besnier derives special interest from the fact that general infection seemed to follow operative interference. The possibility of the contemporaneous existence of lupus and other tubercular disease is only to be excluded by more extended observation.

Besides lupus, deeper tubercular ulcerations spreading from caseating and suppurating subcutaneous nodules, and from and around lymphatic glands in which similar changes have occurred, are met with; the former are rare, the latter not uncommon.

Tubercular ulcerations, again, are met with in all the exposed mucous membranes; those about the mouth, pharynx, and larynx will be treated of under those headings. An internal ulceration of mucous membrane, of much interest to the surgeon, is that occurring in the bladder. It is nearly always secondary, a typical example of infection by direct extension either from the

testis or kidney. It may be met with in two forms, resembling those seen in the skin—as ulcerations limited in extent, circular in outline, and extremely shallow; or as deep extensive ulcerations, with considerable infiltration of their base. Besides these, the bladder may be the seat of miliary tuberculosis in the acute general variety.

The clinical appearances and characters of these ulcerations will be met with in the special sections. The only points to be referred to here are their resistance to any treatment short of complete extirpation, their liability to recur, and their tendency to attack certain localities.

TUBERCULOSIS OF LYMPHATIC GLANDS.—This is one of the most common forms of local tuberculosis. It is usually secondary, the result of direct infection from the lymphatics; but cases of primary tuberculosis, occurring by way of the blood-stream, are also described. The possible function of the lymphatic glands as safeguards to the system from general infection is, to a certain extent, illustrated by the situations in which tubercular glands are found. Thus, the most common situations are the neck, the infection coming by way of the lymphatics of the nose, mouth, fauces, and pharynx—parts constantly exposed to danger of infection from without—the bronchial glands and the mesenteric glands, also at the root of the respiratory and alimentary systems respectively; less commonly the glands of the extremities, and here more frequently in the upper than the lower, for what reason it is difficult to determine, since bone and joint cases, their most probable primary source, are equally frequent in either. In the case of the neck, it must be noted that in many instances no primary point of infection can be discovered.

When infection occurs by way of the lymphatics, the glandular affection is local; in cases of general glandular tuberculosis the infection occurs by the blood-stream. The glands present some peculiarities in this case, which will be discussed later.

Section of a tubercular gland reveals appearances dependent on the stage of the process. In the earlier stages, the surface will be of a pinkish or pale grey colour; in some cases, whiter or more opaque spots are visible on minute inspection, or when a magnifying-glass is employed. At this time only moderate swelling will exist, and the gland is still soft. Later, a series of changes occurs. The most common is caseation; this occurs at a number of spots, which tend to coalesce, the gland becoming

harder with the development of this process. Section of such a gland may exhibit a number of yellowish areas; when the process is advanced these may be extensive. With the advance of caseation a small-celled new-formation is thrown out around the gland, amalgamating the surrounding tissues with the capsule, blocking up the hilus, and extending along the lymphatic vessels. Where a number of glands are affected, they are in this way amalgamated into one mass, the skin covering them becoming gradually adherent by the extension of the process. Meanwhile, the central portion breaks down, softening extends towards the surface, and a discharge of purulent matter, composed of caseous detritus, shrunken gland-cells, and pus-cells takes place. In other cases the suppuration occurs in the periglandular infiltration, and, when it opens, a tubercular ulcer is formed with the exposed gland lying at the bottom. In such cases healing is slow, occurring only when the whole of the infected gland has been cast off. In place of suppuration, calcification sometimes occurs in the caseating glands, especially in the mesenteric. Caseation, however, is not an invariable sequence; in some cases a fibroid induration develops.

On microscopic examination, such glands exhibit well-marked reticular tubercle; the process commences most commonly in the centre of the gland, and the elements are furnished by hyperplasia of existing gland-structure. Giant-cells are developed between the gland-cells, but in large numbers in the lymphatic vessels, leading to the suggestion, by Mr. Treves, that they are lymph-coagula. Bacilli frequently are not to be found, but they exist in a considerable number of the earlier cases. In Dr. Kidd's cases of phthisis, he found bacilli in glands in six out of thirteen cases; he suggests that the indurated condition of such glands may have something to do with the apparent absence of the organism in the late stages.

In cases of infection by the blood-circulation, tubercles often exist in unaltered gland-tissue.

Signs.—A chronic enlargement of the glands commonly in connection with a primary lesion, the common situation of which has been indicated in the preceding paragraph. The enlarged glands may at first be discrete and free, but, when they have gained an at all considerable volume, they become matted together, lose their distinct outline, and become adherent to surrounding structures. Later, the skin may become implicated, and softening may

result in formation of abscess and fistula. The course may be extremely chronic.

Diagnosis.—The only point of importance is the possible confusion with lymphadenoma. The following particulars are of weight: in both cases a constitutional diathesis exists, the types of which differ, the anæmic appearance, deficiency of red blood corpuscles, rise of temperature, general distribution of the enlarged glands, enlargement of the spleen, and possible hyperplasia in the position of tracts of lymphatic tissue in lymphadenoma, contrasting with the tubercular type, tubercular history, possible concomitant tubercular lesions, and limited distribution in the case of tubercle. Local differences are also well-marked. Individual tubercular glands do not reach so large a size, nor are the collections so large as in lymphadenoma; they tend to suppurate, and are, at any rate, usually surrounded by considerable inflammatory infiltration, neither of which characteristics is met with in lymphadenoma.

Prognosis.—General infection is rare, for reasons already stated. Local prognosis is unsatisfactory; the course is chronic, and recurrences are always possible. If the glands be let run their course, considerable deformity often results.

Treatment.—The constitutional treatment is that of tubercular affections in general; the internal administration of arsenic is sometimes followed by improvement.

Local treatment varies with the stage. The only radical treatment of use is complete extirpation with the capsule. Incision and scraping are likely to be followed by recurrence. Operations should only be undertaken when the glands are not numerous or widespread, and then with a view to obviating the disfigurement likely to accompany ultimate changes, not with the object of removing a local centre. The wounds are best treated with iodoform.

When suppuration and inflammatory infiltration have occurred, the use of the sharp spoon may be inevitable from the implication of surrounding structures. The wounds here should also be dressed with iodoform, all granulations and the mouths of sinuses having been removed.

G. H. MAKINS.

TUMOURS, Non-malignant.—The simple translation of the word tumour is swelling, and yet the adage that whilst tumours are swellings, swellings are not necessarily tumours, proves that the words 'tumour' and 'swelling' are not convertible,

and that, in its technical application, a tumour is something more than, or something different from, a mere visible swelling.

A tumour may be regarded as having *negative* as well as *positive* characters. Of the former, it may be observed that a tumour is not such a swelling as results directly from injury; nor from inflammation, whether of a general or specific form, or involving only some definite structures. Neither is a tumour produced by displacement of an organ, or malformation of any part; nor is it a collection of fluid in a naturally existing cavity, nor a distended condition of some part of a vessel or canal. Hence, traumatic hæmatoma, abscesses, adenitis, gummata, synovitis, hernia, meningocele, hydrocele of the tunica vaginalis, and aneurism, are not tumours in an exact use of the term; although such expressions as 'hernial tumour' are often conventionally employed, as denoting that such a swelling resembles a tumour in some one or more of its positive characters, which are persistency of the swelling, an inherent power of continued growth, and an incapacity either of spontaneous cure or of dispersion by remedial agents of any kind.

In structure, a non-malignant tumour, such as lipoma, adenoma, or exostosis, is of the nature of a localised hypertrophy of a tissue naturally existing in the part. Physically, such tumours may be either subcutaneous swellings, smooth on the surface and more or less closely connected to the tissue or organ in which they are developed, or outgrowths. As regards consistency, they may be either solid, fluid, or mixed, and, if solid at first, they may become cystic, or if fluid at first, the containing cyst may be filled by the growth of an intra-cystic solid tumour.

In the endeavour to define the term non-malignant as applied to certain tumours, it must be observed that this term is a purely clinical expression, and refers to their life-history and to the effects they produce upon the owners. With this in mind, the structure or composition of any tumour may, for the moment, be left out of consideration, and the simplest course will be to state the converse of the signs of malignancy. Innocent tumours do not, when the growth is left to run its course, with unerring certainty destroy the patient's life; indeed, the true state of the case is that, as a rule, a non-malignant tumour exercises no prejudicial influence on the health of a patient. They possess no power of infecting neighbouring parts by an advancing infiltration of the adjacent tissues,

nor of the viscera and distant parts by a subtle deposit of germs of the parent growth, which, in the likeness of the original growth, become new tumours—secondary growths, as they are termed. On the contrary, non-malignant tumours remain always localised even when multiple. Malignant tumours have a distinct proneness to ulcerate; this character is entirely foreign to non-malignant tumours, the skin over which has the same liability to ulceration as, and scarcely more than, any other part. Malignant tumours evince a very constant tendency to recur after removal, in the site of the original growth—a tendency which continues, however frequently the local affection may have been extirpated. Non-malignant tumours are seldom reproduced, and one is tempted to say never, if the whole of the visible growth has been removed.

Cause.—It must be admitted that the usually accepted explanations for the occurrence of tumours are very meagre, and that, in truth, we know very little indeed of any cause based on well-ascertained facts. Developmental errors afford an explanation in congenital hygroma and some dermoid cysts. An excess of formative material in some instances, or a localised hypertrophy in others, may supply a reason for many of the connective-tissue tumours, whilst localised irritation may offer an explanation for the frequency with which tumours are found in similar sites.

The results of obstruction of the duct of a sebaceous follicle may serve to point out how some cysts are formed, whilst the distension of some minute space explains others; and changes, perhaps inflammatory, or possibly degenerative, may explain the growth of a large cyst or a cystic tumour from a small body like a Graafian follicle. For the majority of tumours there seems no satisfactory explanation, nor can we go further than the statement that tumours 'are the result of some inexplicable error in nutrition in the part they affect, and are dependent in the same measure as are the natural tissues on the blood for the appropriate materials of their nutrition.'

Pathology.—A distinctive feature in the histology of a non-malignant tumour is its resemblance to some one or more of the adult tissues of the body, and it has become a pathological axiom that the more complex, the more highly-developed the tissues of a tumour are—the more, in a word, it approaches the type of one of the fully organised normal adult tissues, whether it be fat, gland, or bone—the more surely

is its non-malignancy proclaimed; and whilst there are the greatest differences in the frequency with which the various forms of tumour occur, yet instances of all recognised tissues being found in growths are well-established.

It must not, however, be taken for granted that, from the structure of a tumour alone, its malignancy or non-malignancy can be asserted; for quite certainly sarcomatous elements—i.e. such as resemble some foetal structure—are found in tumours whose general composition is that of one of the non-malignant group, and whose clinical features clearly require that it should be considered innocent. True it is, nevertheless, that, in some instances, features denoting malignancy may be superadded to a growth which, at its commencement, appeared of a simple nature; and, having in view the general similarity that exists between the cells seen in the course of the processes of inflammation (especially those existing during the developmental period) and some typical cells of sarcomatous tissue, surprise cannot be felt that, occasionally, a malignant invasion of an innocent tumour occurs, or that an injured or inflamed part becomes the seat of a malignant growth.

Upon naked-eye inspection, most of the tumours under notice will be seen to be invested with a capsule, which is commonly intimately blended with the growth, but loosely connected to the surrounding structures. Some of the solid tumours are lobed, whilst the cystic may show pouches. As a rule, non-malignant tumours grow much more slowly than the malignant, yet in nearly all tumours periods of active increase occur, and some of the forms of non-malignant tumours attain a great size, notably lipomata; others, again, as the myo-fibromata of the uterus, shrink and may almost disappear coincidentally with the cessation of the menstrual function. Degenerative changes, such as calcification, sometimes are noticed, whilst in other forms there is a great liability to the formation of cysts, the result of a process of softening or a mucoid change ending in the formation of definite cavities. In the case of cysts, which at first may seem quite 'barren,' a sort of germinating process begins, and from some portion of the wall a solid intracystic growth sprouts up, frequently going on to fill up and occupy the whole cavity of the cyst or cysts. Whilst some forms of tumours, particularly those formed of erectile tissue, are congenital or commence in the early period of life, some, like exostoses, grow whilst the bony framework is

growing; others again, like the adenoid tumours of the breast or the myo-fibromata, occur chiefly during the period of functional activity of a particular organ, whilst, again, others—for instance, the prostatic adenomata—mark the declining period of life. Putting on one side growths which are more or less peculiar to either sex, on the whole women seem to grow tumours more frequently than do men.

Symptoms and Diagnosis.—The symptoms of an external tumour are objective—due to the presence of a swelling. The diagnosis of a 'new growth' tumour from a swelling which has been defined to have no claim to the technical term of *tumour*, involves an inquiry into history, mode of origin, and physical characters. In most forms of non-malignant tumours, after careful inquiry and examination, a diagnosis is simple, in many it is palpable; occasionally, the history and physical characters are irreconcilable. In such a case, it is nearly always prudent to give preference to the physical symptoms. Again, in a few instances, the physical conditions of a swelling may allow of a diagnosis of some two or three affections; here the probability of the swelling being one of them on the score of frequency should be allowed to prevail. From the circumstances that a simple tumour is nearly always encapsuled, and can be more or less readily displaced from its ordinary position, whilst in an inflamed part everything feels fixed and adherent, it is seldom that an abscess is mistaken for a tumour; yet an error in the opposite direction has equally to be avoided. One must not assume that because a swelling is inflamed, therefore it cannot be a tumour; an innocent tumour, especially when there is some fluid in it, is very prone to attacks of inflammation. In these circumstances, as indeed may be advisable in others, aspiration of the swelling or the extraction of a small portion of tissue, and its examination under the microscope, will often allow of an exact diagnosis being made.

As between a malignant and a non-malignant tumour, the diagnosis turns upon many considerations, but the characters and relations of the tumour are the most reliable. A non-malignant tumour is, as a rule, both more superficially placed, better defined, and more isolated from surrounding parts; the integument is less often implicated in the growth; its rate of increase is much less rapid; whilst the actual period for which a tumour has existed is, if one of years, often well-nigh conclusive evidence of its harmless nature. As it is

only in the later stages that a malignant tumour visibly affects the health, too much importance must not be attached to this question, nevertheless loss of weight is a common symptom in all malignant tumours.

Treatment.—Dealing with solid tumours first, it is clear that, for the large proportion, the only treatment is the radical one of extirpation. It would be out of place to describe how this should be done, or to go into any of the subsidiary details connected with the operative procedure, whether relating to patients or their wounds; on this subject all that is requisite being to point out the circumstances which either call for an operation or render it unadvisable, as well as to indicate those tumours that can be more appropriately treated by other means.

As a rule, in non-malignant tumours, surgical interference is a question of expediency, since neither life nor even health is often threatened; where they are, as for instance in ovarian tumours, the risk of a capital operation is justly permitted, otherwise the risk involved by the proposed operation should be measured before deciding in favour of it. Subject to these provisions, the removal of a tumour is to be recommended when it is unsightly or distinctly inconvenient from its position or its size, or is painful, or is obviously growing. In some forms of tumour, the possibility of a cancerous or malignant change supervening should influence the decision in favour of operating. In the absence of any of those conditions, an operation is not to be pressed upon a patient.

On the other hand, when by the removal of a tumour an injury, likely to be attended with permanently harmful results to the patient, may be inflicted upon some structure—such, for instance, as the division of a portion or the whole of a nerve in dissecting out a neuroma, or the laying open a large joint in taking away an exostosis—then in these and similar cases an operation must, as a rule, be refused.

Erectile tumours for the most part only require for their cure that the blood in the dilated vessels should undergo coagulation. This may often be accomplished by electrolysis, styptic injections or setons, or possibly even by compression or ligation of the afferent trunk-arteries. Of the electrolytic treatment of tumours, the writer would venture to express the opinion that it is deserving of a more extended trial than it has as yet obtained.

Completely fluid tumours, particularly those pellucid cysts called hygomata, may

be occasionally cured by repeated aspiration, or, this failing, by the injection of Morton's fluid into the cyst; or a seton may be passed through it. But this is liable to lead to a tedious as well as painful suppurative process, and it should not therefore be inconsiderately put into practice. These measures again may be employed when excision of the cyst is impracticable, but, when it is easily removable, that procedure is the best for most fluid tumours, as well as for those tumours which are partly solid and partly fluid.

ALFRED WILLETT.

TUMOURS OF BONE may be either simple or malignant; the latter are by far the most important, forming about one-half of all the tumours which have their origin in the osseous system.

Taking the simple tumours first, we may refer the reader to the article on *Exostosis* for a description of these bony outgrowths or *osteomata*.

FIBROMATA OF BONE are, comparatively speaking, rare, except in connection with the jaws. *See JAWS, Diseases of the*. They also occasionally spring from the base of the skull, and may hang down into the naso-pharyngeal space. When polypoid in form, such a tumour may be very easily snared by a loop of wire passed through the nose and slipped over the growth by a finger in the mouth. For fuller details as to the tumours in this space, *see NASOPHARYNGEAL GROWTHS*. In the long bones, the simple fibroma arises from the periosteum, and pushes aside the adjacent tissues, but does not invade them like the sarcomata. Nor does it in any way destroy the bone to the surface of which it is attached. It is very rarely met with, and can only be diagnosed from a periosteal sarcoma by the length of time that it has existed, by its uniform consistence, smooth surface, and perfect freedom from pain. If a reliable history can be obtained which proves beyond a doubt that it has been of an excessively slow growth, the proper treatment will be to remove it from the bone without interfering with the integrity of the shaft. It must, however, always be remembered that it has a very close affinity to the spindle-celled periosteal sarcoma, for which the limb must be removed at a considerable distance from the growth. Some of the periosteal sarcomata, having a large admixture of fibrous tissue, and being in consequence exceedingly dense and firm in structure, resemble very closely the fibromata. These have been called fibro-

sarcomata, and are more fully described in the latter part of the article *SARCOMA*.

ENCHONDROMATA OF BONE, when purely cartilaginous, are simple tumours which do not return after their complete removal. If such a tumour shows the characteristics of a malignant growth, it is almost certain that the cartilage is mixed with other embryonic tissues, and is practically a chondrifying sarcoma. An enchondroma in most cases, closely resembles hyaline cartilage, which presents itself in a more or less embryonic form; but it may have a varying amount of fibrous tissue in its matrix, and in this way simulate fibrous cartilage. Calcification and ossification may also take place, and, in the latter instance, partly convert the tumour into an osseous growth. An extreme example of this change is seen in the cancellous exostosis (*see Exostosis*), which is generally covered by a layer of cartilage, and increases in size by the ossification of its cartilaginous cap. Fatty and myxomatous tissue are also not uncommonly present, especially in the larger tumours (*chondro-myxoma*). These changes may convert different parts of the growth into a soft and diffuent mass, and even produce distinct cystic cavities. Since the microscope has been more generally used for the minute and thorough examination of all new-growths, it has been found that, even where the tumour appears to the naked eye to be almost entirely composed of cartilage, a certain admixture of the other embryonic tissues may be discovered. It is also known that a sarcoma of bone may, in part, be converted into cartilage. Putting these two facts together, most surgeons believe that, where an enchondroma returns after removal, or is widely disseminated in the glands and viscera, the case is not one of simple enchondroma, but a mixture of two growths, both starting from embryonic tissue, or more probably a sarcoma in which a part of the embryonic tissue has become cartilaginous—i.e. a chondrifying sarcoma. In former days it was very probable that the sarcomatous element would be overlooked, when the tumour appeared to be almost entirely composed of cartilage.

Situation.—The pure enchondromata of bone are most commonly found arising from the phalanges or metacarpal bones. They are then frequently multiple, so that a patient may have one hand distorted by several of these tumours. Both hands and both feet may be similarly affected, but it is far more common in the former than in the latter. Though often multiple

these enchondromata are generally small, but their size is quite sufficient to very seriously interfere with the functions of the hand or foot. These small multiple enchondromata usually arise in the medullary cavities of the smaller bones just named, so that a complete shell or plates of bone are generally found upon the surface. A cartilaginous tumour arising on the other and larger bones is always single, and may assume enormous proportions. The scapula and pelvis are common sites for these growths, so also are the adjoining parts of the femur and tibia; but scarcely any bone in the skeleton can be said to be free from the possible development of an enchondroma. In these cases they generally grow from the periosteum, and are consequently attached in many cases only to the surface of the bone; but the latter may be partially absorbed by pressure. Many of those enormous tumours which are described in our surgical literature as enchondromata would, in the present day, be classified as sarcomata, for the reasons that have been already stated at the commencement of this article.

Age.—The multiple tumours of the hands may occur either during childhood or in the young adult, but the majority arise before the age of puberty. With regard to the single and larger growths, they are generally seen at a somewhat later period of life, but it is difficult to form any decided opinion as to the usual limits of age, on account of the uncertain nature of the tumour in most of the recorded cases.

Diagnosis.—A cartilaginous tumour is globular in outline, with a slightly lobulated surface, but this is nevertheless perfectly smooth in each of its larger and smaller subdivisions. Its consistence may vary from a very dense and solid growth to one which, with some confidence, may be thought to be in part cystic. The outline can be very clearly felt, being distinctly circumscribed, and, as there is no infiltration of the surrounding tissues, the skin and muscles may be made or seen to move without traction upon the tumour; in its simplest form it merely pushes aside the overlying and adjacent structures, without invading them in its growth. As a general rule, it is perfectly painless, unless some nerve be accidentally stretched or pressed upon. There is consequently no inconvenience complained of except from its weight and size. It is exceedingly indolent and slow in its growth, occupying many years in attaining any great size. Rapidly growing enchondromata have been described and thought to

be a malignant type of cartilaginous tumour, from the fact that they sometimes returned after removal either in the site of operation or in the glands and viscera; but, as has been before explained, it is very doubtful whether they are not sarcomata in which chondrification had taken place.

The enchondromata of the hand, whether multiple or single, do not, as a rule give rise to any difficulty in diagnosis. The age at which they occur, the particular bones affected, their central position in these bones, their slow growth and freedom from pain and tenderness, combine to make the diagnosis tolerably easy. The consistence may vary considerably in different parts, so that a deceptive sense of fluctuation may at times be detected; but although in such instances the bone has evidently been perforated by the growth, osseous plates will be found in some parts of its surface, and the general impression will be that of an elastic central growth rather than a fluid tumour. In its early stages it might possibly for a time be confused with a so-called 'strumous phalanx,' which is also most commonly seen in childhood. The metacarpal bone may be affected in a similar manner by a strumous osteitis. But in the latter cases some signs of inflammatory infiltration would be felt in the superficial structures, and tenderness on pressure. The enchondroma, though globular in its general outline, has usually small rounded projections on its surface; but the skin and superficial structures are never infiltrated and adherent to the parts beneath, as in the strumous disease of the phalanx and metacarpal bone. As time goes on and suppuration takes place, some shortening of the bone is produced and the swelling diminishes in size, whereas the enchondroma steadily increases without any signs of inflammation or suppuration.

Syphilitic disease of the phalanges, which is seen in young children, is generally distinguished by the fusiform enlargement of the whole bone without any tendency to suppurate, and by the history and other signs of syphilis. It has never the globular outline of an enchondroma, nor its elastic sensation on pressure. The tumour also only occupies a part of the bone, and generally one of its extremities.

The larger enchondromata, which occur in other parts of the skeleton, may give rise to greater difficulty, for although we may be able to say that a given tumour contains cartilage, yet we cannot always feel confident that this is the particular tissue which controls the sequel of the case. As has been

already pointed out, the cartilage may be in part ossified, but this and other simple changes are of less consequence than the possibility of the presence of sarcomatous elements in its structure. The real difficulty in these cases will lie between the simple periosteal enchondroma and the chondrifying periosteal sarcoma. The history will generally be the most important point in the decision of this question.

The rapidity of growth in the case of the enchondroma is commonly measured by years; whereas, in the sarcoma, months, or even weeks, produce a visible alteration in the size of the tumour. Pain is also frequently complained of in the sarcoma, and in some cases is a very conspicuous feature, keeping the patient awake at night for many hours; an enchondroma, on the other hand, is, as a general rule, quite free from this distressing symptom, and only gives rise to inconvenience from its size.

In an enchondroma there should be no infiltration of the surrounding parts, so that the tissues ought to move smoothly and easily over the tumour, whereas in the malignant growth the reverse is generally the case.

The *treatment* of a simple enchondroma depends somewhat on the part that is involved and the inconvenience which it causes. In the hand, the tumour may sometimes be removed without the loss of the bone, but it can only be done where the growth has not converted the shaft into a mere shell. The writer of this article excised an enchondroma from one of the metacarpal bones, which had grown from its medullary cavity but projected only on the flexor aspect, leaving the cortex of the shaft on the dorsum perfectly free. The tumour was removed from the flexor side, and the thin strip of cortical bone left *in situ*. The patient recovered with the perfect use of his hand, and no recurrence took place. But, as a general rule, the bone is so disorganised that the whole of it has to be taken away. Amputation of the finger with its metacarpal bone, if the latter be involved, is therefore the usual method of giving relief where an operation is required. It must, however, be remembered in these cartilaginous tumours of the hand that the growth is, after all, benign, and that it generally ceases to increase before it has attained a large size. Consequently, when it does not interfere with the usefulness of the hand, it may be wiser not to remove a part of so much importance as a whole finger with its metacarpal bone, unless the patient is himself exceedingly anxious to

have it done on account of the deformity. On the other hand, if a finger is already disabled by such a tumour, it had better be removed.

It is difficult to lay down any rules for the large single enchondromata which grow from the long and flat bones, such as the femur and scapula, for they differ very much in their importance. One that is slowly but steadily increasing should be removed, for it may in time assume such a size as would, from the magnitude of any subsequent operation, of itself endanger life, and one can scarcely estimate the inconvenience and disability to which it may eventually give rise. An exploratory incision may be made to see if it can be removed from the bone to which it is attached. In some cases, it may be taken away without destroying more than a limited portion of the bone from which it grows; in others, the shaft of a long bone may be so injured as to necessitate the amputation of the limb. An enchondroma of moderate size, attached to one of the larger bones and perfectly stationary in its growth, may, for a time at least, be left without interference, particularly if its removal would entail some loss of function in the part to which it is fixed. But the patient should be cautioned as to the possibility of its increase, and the necessity in that case of again consulting his medical adviser. When, however, a tumour appears on examination to be an enchondroma, but yet has increased very rapidly in size and shown other signs of being malignant, it should be treated like a sarcoma, and the limb be removed at once well above the seat of the disease.

SARCOMATA OF BONE.—General articles on **SARCOMA** and **MALIGNANT TUMOURS** affecting all the tissues and organs, but not especially referring to bone, are given elsewhere. Although this subject has been discussed in the manner indicated above, yet it is thought desirable to give more fully in this article an account of the sarcomata in their special relation to bone, for they are by far the most important of the tumours which start in the osseous system. It will not be necessary to again describe the structure of the different varieties of these tumours.

Cause.—The theories as to the etiology of these growths have been very fully discussed under **MALIGNANT TUMOURS**, and it is here only necessary to emphasise a fact of some clinical importance—that a very large proportion of the sarcomata of bone are traced by the patients to some definite injury, such as a blow, a kick, or a fall,

Central and Peripheral Sarcomata.—

These may start from the centre or from the surface of a bone, and it is exceedingly difficult in some of the flat bones, such as the skull, scapula, and ilium, to say where the tumour commenced. But in the long bones there is not, as a rule, any difficulty in distinguishing between the two, even during life. The parosteal tumours, or those which are connected with the outer layer of the periosteum, will not be included in the periosteal or peripheral tumours of bone, as it is probable that they only secondarily invade or become attached to the periosteum. The periosteal or peripheral sarcomata develop generally from the osteogenetic layer of the periosteum, and are especially prone to be in part calcified or ossified. The bone itself upon which they are seated may be normal or itself invaded by extension through the Haversian canals.

Mr. Butlin has ably pleaded against the use of the word 'osteoid' in relation to these changes of structure in the periosteal sarcomata. We have no space here to produce his arguments against the term 'osteoid,' which 'implies the presence of a substance like bone, yet not bone.' Suffice it to say that ossifying, calcifying, or chondrifying sarcoma is distinctly more correct, and at the same time more nearly expresses the changes that may occur in the periosteal growths. An equal objection may be taken to the word 'osteosarcoma,' which has been used with very various meanings. After removal, these tumours, which spring from the periosteum, have in most instances a distinct radiation from the bone upon which they are placed. The columns or lines appear to be produced by the calcification and ossification round the small vessels which run from the periosteum at right angles to the bone. As the tumour increases in size, the periosteum is farther removed from the bone, so that the area in which this radiation and subsequent ossification or calcification may occur becomes larger, and occupies a greater part of the new-growth. But bone is never found in the capsule or outer part of the tumour. The central sarcoma starts in the medullary canal, and gradually approaches the surface by destruction and expansion of the bone within which it grows. As it reaches the surface, the periosteum, irritated by its presence, produces new bone to encapsule the growth; so that, as it increases in size, a shell of new bone is still found upon its exterior. This is the distinguishing feature both in a clinical and a naked eye examination of the difference between the central and peripheral tumours

of bone. This encapsulating shell of bone is, however, rarely complete, and may only be represented by a few osseous plates.

The microscopical and naked eye appearances of the different varieties of SARCOMA will be found under the article of that name, and need not be repeated here. The round-celled, spindle-celled, mixed-celled, and myeloid sarcoma, which is the classification there adopted, may each of them attack the various parts of the human skeleton. The last one only of the group is confined, almost entirely, to the tumours arising from the gums and the cancellous parts of the bones, whilst the other varieties may be found equally in the central and peripheral sarcomata. From a perusal of the article just alluded to, the reader will find that other subdivisions might be made according to the secondary changes to which many of them are liable. It is here only necessary to mention those which are of practical and clinical importance. One form, in which there is often a large development of bone, has been already mentioned in describing the periosteal sarcoma. Cartilage may also be found, and is especially referred to under *Enchondroma*. The cystic and vascular conditions which are sometimes found are of still greater importance, as they are liable to be misunderstood. These tumours are all of them, but especially the central sarcomata, liable to degenerative changes. They may be in part cystic, myxomatous, or fatty, and the possibility of these conditions being present must not be forgotten in an examination of any particular case, as it will give rise to different degrees of density in various parts of the growth. The central sarcomata are also often exceedingly vascular, a circumstance which at one time leads to hæmorrhages into its substance, and at another to distinct pulsation. In an analysis of 165 cases of sarcoma of the long bones by Gross (*American Journal of Medical Science*, July and Oct., 1879), it appears that pulsation was noticed in twenty per cent. of those that were central; whilst in the flat bones, such as the skull and innominate bones, it has been very frequently observed in both the central and peripheral tumours. But of all the sarcomata of bone, it is perhaps most common in those cases in which several bones are simultaneously affected.

The malignancy of these sarcomata is shown by their tendency to return locally after removal, by the occasional invasion of the lymphatic glands, and by the frequent occurrence of deposits of the same growth

in distant viscera, especially the lungs. But they differ very much in the degree of malignancy which the various forms present when arising from bone. Some sarcomata invariably return locally or appear elsewhere, no matter how early in the course of the disease or how far removed from the seat of the tumour the operation is performed. On the other hand, the myeloid sarcomata so seldom return after removal that some surgeons look upon them as benign growths, and have even urged that they should be merely scooped out from the bone in which they are embedded. But of their occasional recurrence, especially after this latter operation, there can be no

doubt, so that they must still be looked upon as malignant tumours. The following table, taken from Gross's article on 'Sarcoma of the Long Bones,' already quoted, shows this point extremely well. It will be seen by this analysis, which is based upon a study of 165 cases, that the periosteal growths are much more malignant than the central sarcomata, and that these again each differ considerably amongst themselves; so that the periosteal spindle-celled sarcoma appears at the head of the list as the most malignant of all, and the central myeloid at the other end of the list, as the most innocent or least malignant of all sarcomata arising in bone:—

Variety of Sarcoma	Infection of adjacent tissues, as shown on dissection after removal	Local recurrence after operation	Infection of glands	General infection
	per cent.	per cent.	per cent.	per cent.
Periosteal spindle-celled	44	60	—	100
„ round-celled	50	50	7·69	66·66
„ osteoid	40	41	6·25	65·62
(?ossifying)				
Central round-celled	66	25	8·33	33·33
„ spindle-celled	18	20	—	23·07
„ giant-celled	12	8	—	22·72

The invasion of the lymphatic glands is not by any means a common occurrence, and would seem, from its rarity, to be due in most cases to the chance position of the primary growth. Thus, it is much more common when the tumour arises in the bones of the pelvis or skull than when it starts in any of the long bones. In the pelvis it is probably due to the direct implication of the glands, which are so numerous in this region, and, when once any gland is involved in the infection of the adjacent tissues, the disease may easily be carried on to the others. In the skull several tumours may simultaneously arise, or many of the bones and viscera be affected by the same growth. The blood-vessels in such cases must be looked upon as the medium through which the disease is disseminated. Indeed, there is but little doubt that this is the ordinary way in which the viscera become the seat of the secondary tumours. The lungs are far more frequently affected than any of the other organs, a fact which strongly supports this view of the means by which general infection of the system is produced. As is shown by the table quoted above, the percentage in which this general dissemination of the disease occurs is much higher in each variety of sarcoma than

that of the local recurrence after operation.

Although most commonly seated in the articular extremity of a long bone, the joint is very rarely invaded. The bone may be almost completely destroyed, forming a mere shell around the growth, or represented by a few bony plates upon its surface, but the cartilage still opposes a barrier to its entrance into the joint. Cases are, however, recorded in which the tumour has passed through the joint, and invaded the opposite bone entering into the articulation. In the periosteal sarcomata the invasion usually takes place through the synovial membrane, but in this case also it is a very rare occurrence.

The *favourite seat* of both the central and periosteal sarcomata, if we exclude the jaws, which have been considered in another article, is the articular extremities of the long bones, and one epiphysis is more likely to be attacked than the other. For example, it is much more common for a sarcoma to arise in the lower end of the femur and the upper end of the tibia than in any other parts of these two bones. To quote again from Gross's admirable article, it will be seen that out of 165 cases which he analysed,

The femur	{ was the seat of {	67 instances
The tibia	" "	46 "
The humerus	" "	25 "
The fibula	" "	13 "
The ulna	" "	7 "
The radius	" "	6 "
The ulna and radius were	{ " "	1 instance

Thus the bones of the lower extremity are far more frequently affected than those of the upper, the femur, tibia, and fibula being the seat of the disease in 76 per cent. of all his cases.

It is interesting also to note, in an analysis of the histological structure of the tumours in these same cases, that the myeloid or giant-celled sarcomata formed about 42 per cent. of the entire number, and that the central tumours collectively exceeded the periosteal by about 18 per cent. We have already shown that the central are less malignant than the periosteal sarcomata, and that, of the central growths, the giant-celled are the least likely to show any malignant tendency.

Symptoms and Diagnosis.—The sarcomata of bone occur chiefly at an early age, by far the larger proportion developing before the thirtieth year. Their favourite situation has been already discussed. The external contour of these growths will vary with the position and nature of the tumour. The central are generally spherical in outline, wherever they may be situated, whilst the periosteal sarcomata are long and fusiform in the shaft, and pyriform at the extremities of a bone, with the base directed towards the articulation. This gradual diffusion along the shaft is very characteristic of a peripheral sarcoma. The periosteal tumour may be situated at first only on one side of a bone, although, as a rule, it quickly surrounds it in its further growth. The central will have a distinct bony capsule or numerous bony plates upon its surface, and, if the tumour be soft and cystic, will often yield a sensation of 'egg-shell crackling.' The periosteal growth will be smooth or tuberculous, with no bony plates upon its exterior.

In either case, the density and resistance to pressure will probably vary in different parts, the tumour being in some cases exceedingly firm and in others so soft as to give rise to a doubtful sense of fluctuation. But the growths may also be uniformly hard or soft throughout, or even in part distinctly cystic. Pulsation is of fairly frequent occurrence in the central tumours of the long bones, and is also found in some of the multiple periosteal growths of the flat ones.

If pulsation is felt in the articular extremity of a long bone, it may fairly be assumed that the case is one of central sarcoma. It has happened to the writer to have to treat a case of pulsation over an area of about half an inch in diameter on the inner surface of the head of the tibia, in which there was no expansion of the bone and no tumour to be detected. In submitting this case to operation, the whole of the interior of the head of the tibia was found excavated and replaced by a soft, almost fluid, and highly vascular pulp. This, on careful examination, proved to be a myeloid sarcoma. The size to which these tumours may grow varies enormously, and no opinion can be formed as to their nature from this circumstance alone. Some, while still quite small, will have produced general infection of the system; whilst others, which have assumed gigantic dimensions, may yet not return after complete removal. Spontaneous fracture may occur in either the central or peripheral form of growth, and in some cases is the first indication of the disease. If no swelling has been previously present, it very quickly appears on the occurrence of the fracture. In those periosteal cases in which calcification or ossification takes place, this accident is not likely to happen, but in the softer tumours, which extend through the Haversian canals, eroding the bone, it is as prone to occur as in the central sarcomata. Pain is almost always a prominent symptom, and is sometimes very severe, making life so intolerable that, on that account alone, the removal of the part affected may seem desirable. It is perhaps less frequent in the myeloid tumours, but in the other forms of sarcomata of bone it is almost invariably present, in more or less severity, throughout the course of the disease. Pain is, indeed, often the first symptom which attracts the patient's attention to the presence of a swelling, and should always be looked upon as of gravest import when it cannot be traced to the distribution of any definite nerve-trunk. In the latter case a simple tumour might, from its accidental position and pressure, be the origin of the pain.

The rapidity with which the sarcomata of bone increase in size, and the duration of life without operation vary enormously. It is, however, upon this symptom that the diagnosis chiefly rests, and it would be, in most cases, impossible to distinguish the sarcomata from the simple tumours of bone, without knowing the length of time that the swelling had existed. As a rule, the rate of increase is, in the former, measured

by months or even weeks, and in the latter by years. In some instances there may be a kind of pause in the rapidity with which the disease advances, but, generally, the increase is uninterrupted in its progress till death occurs, in from one year to eighteen months in the case of the more rapidly growing tumours, whilst in the more chronic forms life may be prolonged for two or even several years.

The diagnosis of a sarcoma from an innocent tumour of bone is generally easily formed from the history of its rapid growth, from its varying consistence in different parts, from the constant presence of pain, and from the well-known fact that it is of much more frequent occurrence than any other kind of growth in bone. Some difficulty will occasionally arise when the tumour is exceedingly firm, of considerable size, with a clearly defined margin and a lobulated surface. If of slow growth, such a tumour would naturally be considered to be a simple enchondroma; when, however, it has been rapidly increasing in size, the probability will be in favour of a sarcoma which is chondrifying; and if it be seated in the articular extremity of a long bone, such as the lower end of the femur, the probability will approach a certainty, as may be gathered from the remarks in the preceding paragraphs.

In very rare and exceptional cases, some forms of inflammation of bone may be mistaken for sarcoma, especially as a hectic temperature is not unknown in some instances of the latter affection. The soft tissues in the rapidly-growing variety of sarcoma may also be hot, œdematous, and infiltrated, as if from inflammation. The converse also takes place, in which the inflammatory affection is of such a chronic type as to simulate very closely the early stage of a central sarcoma of bone. Mistakes of this kind have been made, and could not, apparently, have been avoided. They have mostly been described under the name of 'necrosis without suppuration,' to which and its clinical distinction from sarcoma a reference will be found in the concluding paragraph of the article on SARCOMA. In any doubtful case the tumour should certainly be incised, and, if necessary, the bone trephined, so that no time may be lost in excluding or confirming the presence of a malignant tumour. There should be no difficulty in distinguishing a sarcoma of the articular extremity of a bone from disease of the neighbouring joint; for, even in the rare cases of invasion of the articulation by the new-growth,

to which allusion has been previously made, the occurrence only takes place in the later stages of the disease, when the diagnosis will probably have been already made. In the case of the tumour, the joint will not be uniformly enlarged nor form the centre of the swelling; its freedom of movement will not be much, if at all, impaired; no pain or grating will accompany its action, and no improvement will be produced by the perfect rest obtained from a splint, but, on the contrary, the tumour will continue to increase in size.

Pulsating tumours of bone will be found discussed under OSTEO-ANEURISM, but there is very little evidence to show that there is any other growth in bone giving rise to pulsation, except the sarcomata which have been already described. From an ordinary aneurism in the groin or popliteal space, the diagnosis may at times be attended with considerable difficulty. The points, however, of importance would be the situation of the tumour, which might be out of the line of the vessel supposed to be affected, the incorporation of the growth with the bone upon or within which it is placed, the presence in many cases of bony plates upon its surface, the ill-defined outline in the periosteal form of growth, and the less impulsive character of the pulsation as contrasted with that of an aneurism. The arterial pulse below—as, for example, at the ankle—will be altered or possibly absent in the case of aneurism, whereas, in the pulsating sarcoma, it will be of the same size and character as that of the corresponding artery of the opposite limb. On compressing the artery above, the tumour also cannot be much diminished in size by pressure, whereas the aneurism may be partially emptied, and the solid growth may be more easily felt and appreciated. That it is, at times, exceedingly difficult to distinguish between the two in the situations mentioned above, is evidenced by the fact that arteries have been ligatured by the most experienced surgeons for tumours supposed to be aneurisms, which have subsequently proved to be pulsating sarcomata.

Treatment.—Amputation at the earliest possible moment, whenever it is possible, is undoubtedly the proper treatment to pursue. The only question of importance is the site of operation. Even in those cases where we know that the growth will almost certainly return elsewhere, the limb should still be removed if the patient is suffering any pain. And there are very few cases in which pain is not experienced, which steadily increases in severity, and may be entirely

relieved by operation. The best plan will be to take the individual bones *seriatim* and to discuss the operation which the writer thinks most suitable for the sarcomata which affect them.

In the case of the *tibia* and *fibula*, which may be taken together, much will depend upon whether a decided opinion can be formed as to the central or peripheral origin of the growth. The periosteal sarcomata should be very widely removed, as they have a great tendency to infiltrate the surrounding tissues. Consequently, when it is quite clear that the growth is a periosteal one, there should be no hesitation in amputating through the lower third of the thigh or through the knee-joint, unless there is plenty of room between the tumour and the part immediately involved in amputation below the knee. If a periosteal growth involve only the lower part of the tibia or fibula, either of the two latter operations would be feasible, provided there is a very large margin of healthy tissue between the flaps and the tumour. There is no reason to suppose that the tumour would be likely to return in the stump of the tibia in the amputation below the knee if these conditions be observed; in fact, experience rather proves that the disease more frequently returns elsewhere. But there are very few cases of sarcomata in this position which, when they come under observation, have not made such rapid progress as to require the higher operation; and, as a general rule, an amputation through the lower third of the thigh should be preferred to one below the knee. If, however, the case is one of periosteal sarcoma in the upper end of the tibia or fibula, an amputation through the middle of the thigh would probably be indicated, as there would scarcely be room to form healthy flaps in an amputation through the lower third of the femur.

The central sarcomata will allow of more lenient treatment, on account of their malignancy being of a less marked character. An amputation may therefore almost certainly be performed below the knee in a case of central sarcoma involving the lower ends of tibia or fibula, but the sawn surface should be carefully examined, for fear of any extension of growth along the medullary cavity. If this be found, it would be best to complete the operation by removing the upper end of tibia and fibula—in fact, by amputating through the knee-joint. For a central sarcoma of the upper end of tibia or fibula, amputation through the lower third of the thigh would probably be sufficient, if there

were plenty of room for the flaps. In the middle of the shaft, the central sarcoma is likely to be of the round or spindle-celled variety, which is more malignant than the myeloid. It would, therefore, be wiser to give more space between the growth and the site of operation. As regards the enucleation of a central sarcoma from the bone in which it is situated, it is, in the writer's opinion, a very doubtful policy. In most cases, the bone is reduced to a mere shell after the removal of the growth, and, even if successful, so far as the tumour is concerned, enucleation would be unlikely to leave a leg capable of bearing any weight in walking. There is also another danger, which occurred to the writer of this article. The tumour will very probably encroach so much upon the neighbouring joint that, after its removal, the cartilage only may be left between the cavity in the bone and that of the joint. In the case referred to, amputation had to be performed a week or two after the first operation on account of a secondary synovitis, and, when the limb was removed, the condition described above was found. The patient made an excellent recovery, and has had no recurrence of the disease up to the present time, which is two years since the removal of the limb. Resection of a central sarcoma of the fibula, with the part of the bone affected, has been successfully accomplished by Langenbeck, and might certainly be attempted if the disease were not too far advanced; but the tibia could scarcely be so treated, although in the case of a myeloid sarcoma the disease would probably not return.

If there is any doubt as to the nature of the growth and the consequent site of operation, it would be best to make an incision into the centre of the tumour, when its endosteal or peripheral origin would be decided, and the amputation selected on the lines indicated above.

In the *femur* there is much less choice of operation, but the same rules which have been already mentioned will guide the surgeon aright. The periosteal sarcoma of the lower articular extremity of the femur will require an amputation as far removed from the seat of the tumour as is consistent with safety to the patient's life. If it has already spread along the shaft, the limb should be removed just below the trochanters. If the disease be seated in the centre of the femur, nothing less than amputation at the hip-joint ought to be entertained, but the mortality after this operation is exceedingly high. It is right, therefore, considering the immediate danger to life,

that the nature of the case should be fully explained to the patient or his friends, so that they may judge whether the risk is worth running in view of the very probable return of the disease, to which a glance at the foregoing table will recall the reader's attention. What difference the various later modifications of amputation at the hip-joint will make in the immediate risk to life, future experience must prove. In the ordinary flap operation, the soft tissues are retained. Furneaux Jordan's method, which is so suitable for cases in which excision of the hip has been unsuccessful, is also objectionable in periosteal sarcomata for the same reason. Cutting short flaps from without inwards, and retaining as little of the deeper tissues as possible, would probably be the best for the patient, so far as recurrence of the growth is concerned. The immediate risk to life from shock might then be avoided by sawing through the trochanters instead of disarticulating at the hip, provided of course the growth did not extend too far along the shaft of the femur to make this modification of the operation undesirable. For a periosteal sarcoma of the upper extremity of the femur no operation ought, in the writer's opinion, to be undertaken. The patient would almost certainly succumb to the direct effects of the treatment, if the operation were sufficiently extensive to take away the parts infiltrated by the disease. The sarcoma would also probably return in the stump before the wound had closed, and little or nothing would have been gained by the operation.

The central tumours may be treated, as in the case of the tibia and fibula, with greater leniency, particularly if there is reason to suppose that the case is one of myeloid sarcoma. A much larger proportion of the central growths are limited to the lower epiphysis of the femur than is the case in the periosteal sarcomata. They are, also, much less likely to be diffused in the surrounding tissues, so that an amputation through the middle of the thigh will, in most cases, be sufficient for a central tumour of the lower epiphysis. The sawn surface of the femur must be carefully examined, and if there be any doubt as to the possible extension of the disease along the medullary canal, another section must be made till a perfectly healthy part is reached. For a central tumour of the middle of the shaft, amputation through the trochanters or a disarticulation at the hip might be performed; the decision, as to which would be the best operation, being

made according to the special features of the case.

For a central tumour in the upper end of the femur, disarticulation at the hip-joint should certainly be undertaken, if there be any chance of the patient surviving the immediate risks of the operation. This would give by far the best prospect of permanent recovery from the disease; but if, from any special reason, this was thought undesirable, resection of the head, neck, and great trochanter might be attempted. The immediate risk to life would probably not be so great, but the subsequent progress of the case would be much more exhausting to the patient's strength than in excision for disease of hip, and recurrence of the growth would be more likely to take place than after amputation. Still, if the disease were not too far advanced, it would certainly be right to give the patient this last chance, in the case of a central sarcoma of the upper epiphysis of the femur. It is well to bear in mind that the hæmorrhage in such an operation would probably be very considerable, if one may judge from the records of cases of resection for sarcomata in other bones.

In the *forearm* the same distinction should be made between the central and peripheral tumours, the latter requiring amputation through the elbow or just above the condyles of the humerus, according to the position and extent of the primary growth. In some of the rapidly growing periosteal tumours, the disease extends very quickly along the muscles and their sheaths. Where this appears to be probable, from the infiltrating nature of the growth and its rapid increase in size, the amputation should be done at the junction of the middle and lower third of the arm, above the humeral attachments of the muscles of the forearm. The central sarcomata are almost entirely limited to the lower third of the radius and ulna, and may in many cases be removed by enucleation or resection. In the case of the ulna, the latter operation is particularly favourable, as it may be done without opening the wrist-joint. Should there be a doubt as to its central or peripheral origin, an incision ought to be made and the finger introduced, for if it proved to be a central sarcoma, but yet too extensive for enucleation or resection, amputation might still be performed through the upper third of the forearm, if the soft parts were not already infiltrated.

In the *humerus*, disarticulation of the shoulder-joint will probably be required for

both forms of disease. The periosteal, which is nearly always situated in the shaft of the bone, must be treated in this manner on account of the principles already enunciated in speaking of the other bones; and the central, which, with very few exceptions, has its origin in the upper epiphysis, most frequently requires this operation from the large size and extensive nature which a central sarcoma so rapidly assumes in this position. Resection of the upper end of the humerus has been performed with a large portion of the shaft, but hitherto, so far as the writer has been able to learn, without success. In the amputation, the skin only should be retained, especially in the periosteal cases, as there can be no object in keeping the deltoid. The outer half of the clavicle and a portion or the whole of the scapula have also been removed at the same time, where these parts were involved in the disease.

Portions of the *pelvis* may at times, in quite the early stage of the disease, be capable of removal, but the possibility of doing this will always be exceptionally rare. The same may be said of the *clavicle* and *sternum*. The *scapula* has been more frequently attacked by the surgeon's knife for sarcoma. The inferior segment, when that alone is involved, may be very rapidly and successfully removed; but the excision of the whole scapula, with the arm and outer portion of clavicle, is a very formidable operation, comparable in its results with disarticulation at the hip. The new growth is also almost certain to reappear in the lungs.

The *prognosis* of the sarcomata of bone may be gathered from what has been previously said as to their malignancy. But, after the tumour has been removed and examined, a much safer opinion can be given as to the probable result. It would be wiser, therefore, to withhold any definite opinion till the necessary operation has been performed.

If the tumour proves to be a myeloid sarcoma and has been very freely removed, every hope of a permanently successful result may be entertained. But if it has only been enucleated or resected, a definite opinion, with our present knowledge and experience, must still be withheld for a time. Should it return, amputation may yet be performed with every hope of permanent success. The other central tumours, although more favourable than the periosteal, are not so benign as the myeloid. According to Gross, if calcareous or osseous

deposits are found in *any* of the central sarcomata, they are much more likely to recur. If, after removal, the periosteal nature of the tumour is confirmed, the prognosis becomes much more grave, as the majority return either locally or by general dissemination; in the spindle-celled variety, metastasis occurred in Gross's cases in the proportion of 100 per cent.

CYSTIC TUMOURS OF BONE may be divided into four classes—

(1) Those which are connected with the teeth, and which will be found described under JAWS, Diseases of the.

(2) Those which are due to some other and more important growth. They are here only an accidental formation, and must not be considered apart from the disease in which they arise. For example, they are found in the enchondromata, especially in the myxomatous variety. Cavities, containing serous and bloody fluid, are also not uncommon in the central sarcomata, and were often described in former days under the name of 'spina ventosa.' The large majority of cystic tumours of bone occur under one or other of these two headings, and the reader must refer to the preceding pages for an account of their origin.

(3) Simple cysts of bone must be exceptionally rare. They have, however, been described, but not in recent times, so that, until a modern microscopical examination has been made of such a tumour, we cannot feel sure that some new growth is not, after all, the cause of the cystic development.

(4) *Hydatids* may also, although very rarely, produce cystic cavities in bone. Several specimens are preserved in the museums of St. Thomas's and Guy's Hospitals. The bone becomes thin and expanded, and gives rise to the symptoms of a central cystic tumour. If this can be tapped, a diagnosis may be made by a microscopical and chemical examination of the fluid that is withdrawn. See HYDATIDS. But, from the histories of some of the recorded cases, it would appear that a fracture, occurring spontaneously and from some very trivial cause, is sometimes the first indication of the disease, and an operation, which has been undertaken for the resection of the fractured ends of the bone, has demonstrated the nature of the case by the escape of hydatids through the wound.

The treatment, that must be adopted for hydatids of bone, will vary with the amount of absorption and destruction of the osseous tissue. If a mere shell is all that is left of one of the longer bones, it may be necessary to amputate. But in the flat bones, and in

those cases of the longer bones in which such extensive destruction has not taken place, the hydatids and the cyst-wall may be carefully removed and scraped away, and the wound left to fill by granulation.

PULSATING TUMOURS OF BONE.—It is probable that nearly all the pulsatile tumours of bone are central sarcomata, for an account of which see preceding pages. This question is also discussed under **OSTEO-ANEURISM**, where another condition, which must, however, be exceedingly rare, is described as producing pulsation in bone.

CARCINOMA OF BONE, as a primary disease, is almost unknown; in fact, it is believed by many to be impossible, as there are no epithelial tissues from which it could arise. Secondary growths are not uncommon, especially after scirrhus of the breast. In these cases, carcinoma may develop in the cancellous tissue of almost any of the bones, and may give rise to spontaneous fracture, or only be discovered *post mortem* in the bodies of the vertebræ.

Epithelioma rarely gives rise to second-

ary growths in bone, but often enough involves and partially destroys it by direct extension from the primary growth, as in the lip and tongue. Cancer of bone must therefore be looked for under *Sarcoma of Bone*.
H. H. CLUTTON.

TYLOSIS.—Tylosis or tyloma is the name given to an hypertrophy of the epidermis. It consists of a horny mass, which may be of any size. It occurs chiefly on the palms and soles, but it may develop on any part of the body exposed to constant friction or pressure. Thus, on the hand it may be caused by gymnastic exercises, cricket, rowing, or any occupation calling for the excessive use of the part, and on the feet, at times, the unequal pressure of the shoe produces a thick and horny mass, causing great pain and inconvenience in walking.

Treatment.—Similar to that for hard corn. See CORNS. MALCOLM MORRIS.

TYMPANUM, Affections of the.—See EAR, MIDDLE, Diseases of the.

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ULCERATION.—*Definition.*—A pathological process in which the affected tissues undergo softening and molecular death, and are cast off, partly in a minutely disintegrated, and partly in a liquid state forming a discharge or ichor. The molecular death, minute disintegration, and liquefaction of the affected tissues distinguish ulceration from sloughing and gangrene, in which the tissues die *en masse*, and, retaining their cohesion, are thrown off in the form of a slough or sphacelus. The above definition of ulceration chiefly applies to the process as it occurs in the skin and mucous membrane, or morbid growths in connection with these structures, and in the deeper tissues when exposed in an open wound.

Causes.—The process of ulceration is preceded by the infiltration of the affected part with morbid products, which may be either of inflammatory origin, or due to the less understood departure from normal nutrition that occurs in the formation of new growths. The causes of ulceration, therefore, looked at broadly, resolve themselves into the causes of inflammation and of new growths. These will be found fully dis-

cussed, so far as they are known, in the articles on these subjects. As regards ulcers of the integuments, however, with which this article is chiefly concerned, there are certain well-recognised causes, whether inflammatory or other, which will need special mention. These may be divided into the predisposing and the exciting.

1. The predisposing causes are — (a) *Certain constitutional conditions of the system*, such as exist in struma and syphilis, in some fevers, in the old, and in the badly nourished and cachectic generally. (b) *An alteration or defect in the circulation of blood through the part*: for example, a feeble circulation, such as often exists in the lower limbs of old people; a deficient supply of blood, such as occurs in scar-tissue or in consequence of atheromatous or other degeneration of arteries; and an excessive supply of blood, such as occurs in chronically congested and inflamed parts, and in limbs the subject of varicose veins. (c) *An alteration or defect in the nerve-supply of the part*, such as ensues upon division or other injury of a nerve-trunk, or disease or injury of the nerve-centres—a familiar example of this predisposing cause, when

combined with the exciting one of pressure, is seen in the bed-sores which occur after injuries of the cord in fractures of the spine. (d) *The infiltration of the tissue with certain morbid growths*, as lupus or epithelioma.

2. The exciting causes may often be very slight—indeed, so slight as to escape notice. They may be divided into—(a) *Direct injury of the part*, as from cuts and blows of all kinds, continued pressure, chafing or rubbing the part, the application of irritating ointments, or chemical agents as acids or alkalies, and burns and scalds. (b) *Irritation produced by the presence of foreign bodies in the part*, such as a thorn, bullet, &c., or of extravasated and putrid secretions, as urine, fæces, bile, synovial fluid, &c. (c) *Inoculation with certain specific poisons*, as those of soft chancre, hospital gangrene, &c. (d) *The presence of certain morbid growths*, as lupus, epithelioma, &c.

Pathology.—The process of ulceration may perhaps be best studied as it occurs in the skin, as the result of inflammation. The part is hot, red, and swollen. The cuticle in the centre of the inflamed spot softens, and is separated or rubbed off. The sore thus left gradually enlarges in depth and extent, by the melting away as it were of the inflamed tissues surrounding it; and an ulcer is produced, exuding an ichorous and sanious discharge. Under appropriate treatment, the surrounding inflammation now subsides, the destructive process ceases, the surface of the ulcer becomes covered with a number of minute red points called granulations, the discharge assumes the characters of healthy pus, and the ulcer gradually contracts and skins over from the margins, till finally the raw surface is covered, and a scar or cicatrix remains at the seat of the former wound.

The minute changes which occur in the course of the phenonema above described are as follows:—The tissues at the focus of inflammation, where stasis has already occurred, become infiltrated with serous exudation and leucocytes which have escaped from the blood-vessels. This leads to the increased proliferation of the cells of the cuticle, which are pushed forward before they have had time to assume their horny characters; and the cuticle thus softened readily separates, leaving the dermis raw and exposed. The infiltrated tissues are now softened and disintegrated by the pressure of the leucocytes, which, in their turn, also undergo degeneration, and are cast off along with the liquefied and minutely disintegrated tissues, forming a discharge or

ichor. Thus the ulcer spreads in depth and extent. But if now the cause of the ulceration is removed, the circulation in the surrounding blood-vessels resumes its healthy characters, the abnormal exudation of serum and leucocytes ceases, and whilst the exposed surface of the infiltrated tissue still degenerates into pus, loops of delicate blood-vessels grow out from the neighbouring capillaries, permeate the deeper layers of the infiltrated tissues, and become surrounded with small round cells, formed either from the leucocytes or the cells of the original tissue. These cells are united by a homogeneous intercellular substance, and, together with the capillary loops, constitute the granulations, or more correctly speaking the granulation-tissue. Under healthy conditions, the growth of the granulation-tissue proceeds more rapidly than its superficial degeneration into pus, and so the ulcer is filled up. New epithelium is now formed from the old epithelium at the margin of the ulcer, and gradually spreads over the surface of the granulations till the ulcer is finally skinned over. Islets of epithelium are sometimes seen springing up on the surface of the granulations, unconnected with the epithelium of the margins; but it is probable that this only occurs when portions of the papillary layer, with cells of the rete Malpighii, have escaped the ulcerative destruction. The granulation-tissue is developed into fibrous tissue; this slowly contracts, obliterating many of the blood-vessels, and reducing the size of the ulcer; till at length a smooth, white, fibrous cicatrix, devoid of papillæ, sweat-ducts, hair-follicles, and lymphatics, and but poorly supplied with blood-vessels, alone remains to indicate the seat of the recent sore.

In the ulcerative process by which a portion of gangrenous tissue is separated from the living, the same pathological changes ensue, and are fully described under GANGRENE.

When ulceration occurs in a morbid growth, as in epithelioma, the process of ulceration is essentially similar; the tissues are softened and disintegrated by the pressure of the infiltrating cells, and are cast off in the form of a discharge or ichor. In this case, however, the process is not the result of inflammation; the infiltrating cells are not leucocytes, but those of the morbid growth; and the process is one of continued destruction, showing, as a rule, no tendency towards repair.

The *treatment* of ulceration is given in detail under the various ULCERS.

W. J. WALSHAM.

ULCERS.—When the process of ulceration, whether the result of inflammation or of the breaking down of a morbid growth, involves the free surface of either the skin or mucous membrane, a loss of substance ensues, and the open sore thus left is called an ulcer. An ulcer, however, is not always produced by the process of ulceration alone, but frequently by the processes of ulceration and gangrene combined; as when a portion of skin from an injury or other cause dies, and the gangrenous piece is thrown off by the process of ulceration. The term ulcer, moreover, is often applied to any open granulating wound, left either as the result of an injury or of a surgical operation. The process by which an ulcer is produced has already been discussed under **ULCERATION**. It now remains to describe the various forms of ulcers that are met with in surgical practice, with their diagnosis and treatment.

Varieties of Ulcers.—The names by which ulcers are known have been derived either from the local condition of the ulcer itself or from its specific cause. Thus, when the process of ulceration, however produced, has ceased, and the surface of the sore has become covered by healthy granulations, the ulcer is said to be *healthy* or *healing*; when from any cause, as the too prolonged use of emollient applications, the granulations become pale and watery, it is spoken of as *œdematous* or *weak*; or if, from obstruction to the venous circulation in consequence of excessive contraction of the surrounding tissues (as, for example, in ulcers following burns), the granulations become protuberant and turgid, it is termed *exuberant* or *fungous*. When an ulcer is attended by signs of acute or sub-acute inflammation, it is called *inflammatory* or *inflamed*, the former term being generally applied to an ulcer having an acute inflammatory origin, and presenting signs of inflammation from the first; whilst the latter is used to indicate that the inflammation is a mere accidental condition, the result of local irritation, engrafted on any form of ulcer whatever its previous characters. If the inflammation is very acute, and the ulceration is accompanied by sloughing or by very rapid destruction of the tissues, the ulcer is spoken of as *sloughing* or *phagedænic*. If, on the other hand, the inflammation is of a chronic character, and the edges and surroundings of the ulcer become thickened and infiltrated with inflammatory products, it is termed *callous* or *indolent*. An ulcer, moreover, whatever its other characters, is often styled *varicose* when associated with or dependent upon a vari-

cose condition of the veins of the leg; *eczematous* if surrounded with an eruption of eczema; *hæmorrhagic* when subject to bleeding; *painful*, *neuralgic*, or *irritable* when attended with excessive pain; and *cold* when occurring on the extremities of old people with a feeble circulation. Again, as the result of certain constitutional dyscrasæ, ulcers present well-marked characters, and are named after the affections producing them. Such are the *gouty*, the *scorbutic*, the *strumous*, and the *syphilitic*; whilst ulcers due to the breaking down of morbid growths are denominated *lupoid*, *rodent*, *sarcomatous*, *epitheliomatous*, *carcinomatous*, according to the nature of the growth preceding them.

The characters, diagnosis, and treatment of most of the above-mentioned ulcers will next be given in detail. In studying them, however, it should be borne in mind that, in actual practice, many minor shades of difference in the local condition of ulcers are constantly met with, and that it may be, therefore, difficult or sometimes impossible to assign to any given ulcer an exact place in a nosological table. The local characters of an ulcer, moreover, are subject to continual changes; an ulcer which at one time is callous may at another be inflamed, and at another sloughing. Further, ulcers of specific origin may have their characteristic features so obscured by inflammatory or other local complications, that it may not be until these have been subdued by rest and appropriate treatment that the diagnosis can be determined.

I. ULCERS WHOSE CHARACTERS DEPEND UPON THEIR LOCAL CONDITION.—*The Healing, Healthy, or Simple Ulcer.*—The situation, and at first the size and shape of this, must necessarily depend upon the original ulcer of which it is the healing form. The edges are neither raised nor depressed, inverted nor everted, but smooth and shelving, the healthy surrounding skin shading off into a thin bluish-white and glistening film, which extends over and is finally lost on the circumferential granulations. The base, unless the ulcer has been very deep, is level, or but slightly depressed below the surface of the surrounding parts, and is covered with small, pointed, florid granulations, not painful, and not readily bleeding when lightly touched. The discharge is small in quantity, and consists of laudable pus.

Treatment.—The ulcer, as the name implies, is a healing one, and the less it is meddled with the better. Rest, and a light dressing of wet lint to protect it from fric-

tion or other source of irritation, and the gentle cleansing of the surrounding skin at each dressing, are all that are required. When the wound is very large, healing may be hastened by skin-grafting. *See* GRAFTING. Dr. Hamilton of Aberdeen has recently proposed grafting with small portions of sponge, as a means of promoting the filling up of deep and healthy ulcers. The writer has seen this method tried in several instances at St. Bartholomew's Hospital, but the results were not satisfactory. The granulations grew into the sponge in the way described by Dr. Hamilton, but the wound did not skin over, and the portions of sponge, filled with granulations and consequently adherent to the wound, remained in this state for many months; and it was not until infinite trouble had been taken in picking out the sponge with forceps, from time to time, that the ulcers were at last induced to heal. Cicatrisation was certainly considerably delayed in these cases.

The Exuberant or Fungous Ulcer is characterised, as its name implies, by the overgrowth of its granulations, a condition due to obstructed venous return, and hence frequently met with after burns and other injuries followed by the undue contraction of the surrounding tissues. The granulations, which rise up above the surface and often considerably overhang the edges of the ulcer, are turgid and congested, of a dark red colour, redundant, and closely packed together; they readily bleed, and are covered with a purulent discharge. The edges and surrounding skin are healthy.

Treatment.—Solid nitrate of silver should be applied occasionally until the surface of the ulcer has been reduced to the level of the surrounding parts, and the sore then treated as described under *Healing Ulcer*.

The Œdematous or Weak Ulcer, like the exuberant or fungous variety, is characterised by the uprising of the granulations above the surface of the surrounding skin; but instead of being turgid and dark red from excess of venous blood, the granulations are pale, flabby, bulbous, semi-transparent, watery, and œdematous. They are soft, easily broken, and readily slough, and are covered with a profuse and watery discharge. The edges of the ulcer are smooth, flat, or slightly rounded, and the surrounding parts are healthy. This ulcer generally occurs in connection with scrofulous bones and joints; but any ulcer may become œdematous if healing is delayed, especially where poultices or other relaxing applications have been too long continued.

Treatment.—Equally applied pressure to the surface of the ulcer, painting the granulations with a strong solution of nitrate of silver, or destroying them by solid nitrate of silver and afterwards applying astringent lotions, is the local treatment generally required. It should be combined with the internal use of tonics, cod-liver oil, and a generous diet.

The Inflammatory Ulcer.—All ulcers due to inflammation might, during their formation, with propriety be styled inflammatory; but the term has been restricted to those in which inflammation of the surrounding integuments is the most marked phenomenon. Such ulcers generally depend upon some constitutional derangement, such as may be induced by gout, excessive drinking, &c., and are usually accompanied by more or less fever. Any ulcer, however, when subject to neglect and local irritation, may become inflamed, but these are more often, for the purpose of distinction, styled 'inflamed ulcers.' The inflammatory ulcer is commonly met with in the lower third of the leg, and is of an irregular shape. Its edges are ragged and shreddy, or abrupt and sharp-cut. Its base is very little depressed, void of granulations, dry, raw, and livid red, or bathed in a serous and often profuse and blood-stained discharge, mixed with débris of breaking-down tissues; or, when the inflammation is more intense, covered with a yellow slough. *See* *Sloughing Ulcer*. The surrounding skin is hot, red, painful, and œdematous. When inflammation attacks a previously granulating ulcer, the granulations become florid and swollen, and generally slough, whilst the ulcerative process, if the ulcer itself is previously healthy or stationary, is again set up.

Treatment.—Rest in the recumbent posture, with elevation of the limb, the removal of all sources of local irritation, the application of cold in the form of the lead and opium lotion, or, better, of warmth in the form of poultices and soothing fomentations, is the local treatment necessary; whilst the general health should be attended to by gentle aperients, restricted diet, and tonics.

The Sloughing Ulcer is perhaps most frequently met with in connection with venereal disease. *See* CHANCRE; SYPHILIS. But any ulcer when neglected or subjected to local irritation, especially in feeble and cachectic subjects, may become acutely inflamed and slough, spreading with great rapidity. The edges then appear undermined, inverted, of a dusky red colour, the

redness extending some distance in the skin around. The base is covered by an ash-grey pultaceous or black slough, and, if this is removed, appears red, raw, and void of granulations. The ulceration is generally attended with much local pain and sharp constitutional fever.

Treatment.—The patient should rest in the recumbent position, with the part elevated, and hot poultices or fomentations be applied till the sloughs have separated. Internally, opium should be freely administered, as it not only allays the pain, but appears to have a controlling action upon the inflammatory process. The bowels should be regulated, and the patient confined to a light but nourishing diet. When the ulcer is foul, disinfecting lotions or charcoal poultices must be freely used.

The Phagedænic Ulcer, owing to improved sanitation, better hospital management, and the more scientific treatment of wounds, is, like the sloughing ulcer, seldom seen at the present day except in connection with venereal disease. *See* PHAGEDÆNA; SYPHILIS. The two processes of sloughing and phagedæna are often present in the same ulcer, which is then spoken of as the sloughing phagedænic ulcer, or simply as sloughing phagedæna. Bad hygienic conditions generally, intemperance, want of sufficient and proper nourishment, uncleanness and neglect of venereal sores, and possibly direct contagion from a phagedænic wound by means of infected dressings, sponges, &c., may be regarded as the chief predisposing and exciting causes of an ulcer becoming phagedænic. The pathological process is similar to that which occurs in other forms of ulceration, but the softening and disintegration of the tissues proceed with much greater rapidity, and are generally accompanied with severe constitutional disturbance. The edges of the ulcer when well established, present an irregular, eaten-out appearance; they are swollen, and of a dark purplish-red colour, fading off into a dusky red, and in places undermined and inverted. The surface is devoid of granulations, and is covered by a dark, blood-stained, ichorous discharge, often intermixed with sloughs. The ulcer spreads with fearful rapidity, and, if not arrested, an entire organ, as the penis or the whole of the vulva, may be destroyed, or a large vessel, as the femoral in the phagedænic bubo, may be opened, and the patient die of a sudden gush of hæmorrhage. On the arrest of the morbid process, the ulcer assumes the ordinary granulating appearance and heals in the usual way.

The *treatment* must be both local and constitutional. The ulcer should be thoroughly dried with pellets of cotton-wool or blotting paper, and the surface completely destroyed by fuming nitric acid. The patient should be placed under an anæsthetic, and the acid applied with a glass rod or brush. In less severe cases, boro-glyceride or carbolic acid in the form of a lotion may be sufficient. At St. Bartholomew's Hospital, the writer has seen the best results from the continuous use of the warm bath. In the case of phagedæna of the penis or vulva, the patient is placed sitting in the bath, the water being maintained at a uniform temperature for many hours. The constitutional treatment consists in the administration of full doses of opium, tonics such as iron and quinine, ammonia and bark, and stimulants in amounts varying according to the condition of the pulse, tongue, temperature, &c.; whilst thorough ventilation of the room is absolutely necessary.

The Irritable or Painful Ulcer.—This name is applied to a small, superficial, and very painful ulcer, commonly situated about the ankle, and occurring chiefly in women beyond the middle period of life. The pain, which is the chief characteristic, is sometimes excessive, even preventing sleep, and is thought by some to depend on the exposure of the peripheral terminations of nerve-fibres in the wound. The edges are perpendicular, irregular, somewhat raised, but vary considerably in appearance; the base is either sloughy or of a livid red, the granulations are shrunken or turgid and bleed when touched, whilst small blood-clots are sometimes dotted over the surface. The skin is, for some distance, congested and of a purplish red, and is often left discoloured and slightly thickened after the healing of the ulcer.

Treatment.—The general health should be improved by saline laxatives combined with quinine or iron, and the pain subdued and sleep obtained by small doses of opium. Locally, rest, elevation of the limb, and the application of the lead and opium lotion, will generally suffice. These means failing, the surface of the sore should be thoroughly cauterised with the solid nitrate of silver. In rare instances, it may be necessary to attempt the subcutaneous division of the nerves by passing a tenotome under the most painful spot, in the way described by Hilton.

The description of this ulcer does not apply to the painful fissure or ulcer of the rectum, which is fully treated of under FISSURE OF THE ANUS.

The Chronic, Callous, Indolent, or Atonic Ulcer.—This ulcer is seldom seen except among the labouring poor, in whom it is frequently found on the front and side of the lower third of the leg. It is very chronic and indolent in its course, often existing for many months or years. It is generally inattended with pain, and when small may cause but little inconvenience. It is usually oval or circular in shape, sometimes irregular, and of moderate dimensions; though not infrequently, when subject to long neglect, it extends round the greater part or the whole of the circumference of the leg. The edges of the ulcer are smooth, steep, and rounded, white, callous, and bloodless, quite insensible when touched, and often elevated above the surface. The base is smooth, and covered with a thin sanious or serous discharge, whilst granulations are either absent, or are minute, pale, flabby, and ill-formed. When of long duration, the ulcer is often adherent to the fascia beneath, or even to the periosteum or bone, and the surrounding parts are chronically congested, thickened, and infiltrated; the skin is scaly and pigmented, and the veins are not uncommonly varicose.

Treatment.—The key to the treatment of these ulcers lies in restoring the circulation through the callous walls, by promoting the absorption of the inflammatory products with which they are infiltrated. This is best done by pressure. Before commencing treatment by pressure, however, any transient attack of inflammation should be subdued, the ulcer, if foul, cleansed by carbolic lotions or linseed-meal poultices, and, under any circumstances, the callous edges macerated and softened by poultices or other emollient dressings. Where a week's rest in bed can be taken previously to beginning the pressure, the cure will be greatly expedited. Having brought the ulcer into a suitable condition, pressure may be applied either by a Martin's bandage, or by strapping after the method of Baynton.

A Martin's india-rubber bandage is best used without any dressing. It should be put on before the patient gets up in the morning, evenly and loosely, so that when the feet are placed on the ground it tightens from the natural swelling of the leg. It should be taken off at night, sponged with cold water, and hung up to dry, while the leg should be well cleansed, and a dressing of lint, soaked in a weak carbolic lotion and covered with oil silk, applied to the ulcer for the night. Ointment should not be used, as grease destroys the rubber of the

bandage. Baynton's method consists in carefully and evenly strapping the limb with strips of adhesive plaster, beginning a little below and terminating two or three inches above the ulcer, and then applying a roller bandage from the foot to the knee. The strips of strapping should be perforated opposite the ulcers to allow of the escape of the discharge, and should not be disturbed for a week. The bandage should be re-applied daily, or at least every two days. The writer, when the ulcer is very deep, carefully packs it with very small pieces of lint soaked in black wash till the level of the skin is reached, before applying the strapping, and has found this modification very useful.

When the surface of the ulcer is only slightly depressed, good results have also been obtained by applying to its surface portions of sheet lead, cut to the size of the ulcer and secured to it by strapping and a bandage. Where the ulcer is very obstinate, the edges may have to be pared down, or incisions made through them to the deep fascia, or a blister applied over the ulcer, as recommended by Syme, before beginning the pressure treatment. When very large, and extending completely round the leg, the question of amputation will have to be considered. A callous ulcer, if converted into the healthy condition by the above means, may, when large, be treated by skin-grafting as already described. An ulcer subjected to constant movement, as when situated over the tendo Achillis, must be placed at rest by applying a suitable splint to the leg.

The Varicose Ulcer.—This term is applied to any ulcer dependent upon, or associated with, a varicose condition of the veins. Such ulcers are usually situated on the lower third of the leg, and are generally of the inflamed, irritable, or callous variety. The ulcer will therefore not require further description, and the pathology and treatment of the varicose condition of the veins will be referred to in the article on that subject.

The Eczematous Ulcer is one which is surrounded by an eczematous condition of the skin. The eczema may be either induced by the irritating discharge from the ulcer, or the ulcer may be due to the breaking down of the centre of the eczematous patch, which is then generally the result of a varicose condition of the veins. In either case, the ulcer itself may be of any of the forms already described.

II. ULCERS WHOSE CHARACTERS DEPEND UPON THEIR SPECIFIC ORIGIN.—*The*

Gouty Ulcer.—The small superficial ulcerations of the skin, which are sometimes met with over gouty deposits, have been called by Sir James Paget gouty ulcers. They are characterised by their situation over evidently gouty parts, and by the discharge leaving, as it dries, a chalk-like deposit consisting of urate of soda.

The Scrobutic Ulcer.—Scurvy does not appear to be a specific cause of ulceration, but, when it occurs in a person the subject of an ulcer, the same semi-fibrous material is formed on the surface of the sore as gives rise to the spongy gums, petechiæ, and other local manifestations of the disease. The edges of the ulcer, whatever its previous condition, become swollen and tumid; whilst its surface assumes a characteristic appearance, being 'covered by a spongy, dark-coloured, strongly adherent, fetid crust, whose removal is attended with free bleeding, and is followed by a rapid reproduction of the same material.'

The *treatment* should first be directed to the correction of the constitutional condition, and the ulcer then dealt with according to its local condition.

Strumous Ulcers are most frequently met with in the neck in the course of the lymphatic glands, in connection with strumous bones and joints, on the cheeks and scalp, and occasionally in other situations. They are produced by the softening and breaking down of enlarged lymphatic glands, by the bursting of subcutaneous strumous abscesses, and by the ulceration of the pale, pink, low, flattened elevations, known as strumous tubercles. The ulcers are generally multiple, often confluent, frequently forming an irregular indolent sore in the course of chains of lymphatic glands. Their edges are irregular, of a pale pink or bluish colour, often thin and undermined, but occasionally thickened. Their base is covered by oedematous, pale, often protruding granulations, having a marked tendency to bleed when touched, and exuding a thin, yellowish-green, scanty discharge. Enlarged glands and the cicatrices of former ulcers are frequently present in their near neighbourhood, or, in the case of ulceration of the neck, on the opposite side. The presence of these cicatrices is very diagnostic of this variety of ulcer. They are usually of a pale pink colour, or white when less recent, and slightly raised above the surface of the surrounding skin, which is puckered and variously drawn in towards them, forming cracks and crannies in which particles of dirt are apt to lodge.

The cicatrices sometimes assume the form of irregularly shaped bands, giving the part a peculiar trellis-like appearance. Their appearance in connection with strumous bones and joints is described under those diseases.

Treatment.—Cod-liver oil, or maltine, syrup of the phosphate or iodide of iron in drachm doses, sulphide of calcium in doses varying from one-sixth to half a grain according to the age of the patient, together with an unstimulating diet and residence at the seaside, are amongst the constitutional measures which should be adopted. Locally, red oxide of mercury ointment, or lactate of lead made by pouring Goulard water into milk, will often be of service; but, if intractable, the edges and surface of the sore should be destroyed by nitrate of silver, or pared away, and the base scraped with a Volkmann's spoon. The cicatrices may sometimes be dispersed by repeated applications of blistering fluid, or, if this fails, it may be of advantage to excise them.

Syphilitic Ulcers.—Two forms of ulcer occurring in the course of constitutional syphilis are here described, the superficial and the deep. The primary syphilitic ulcer is described under CHANCRE.

A. *The superficial ulcers* are generally due to syphilitic ecthyma or rupia, or to the breaking down of syphilitic tubercles, and have often associated with them patches of these eruptions on various parts of the body. Any superficial ulcer, moreover, occurring in the course of syphilis, may take on the syphilitic characters to be immediately described. They are generally multiple, and are more common on the trunk than on the extremities. They are usually circular, or crescentic, or of a horse-shoe shape, often spreading by their convex margin whilst healing on their concave. Their edges are sharp-cut, neither inverted nor everted, raised nor depressed, and unattended by induration. Their bases are but slightly depressed, of a dark red colour, and often covered by a yellow slough or an ecthymatous or rupial scab. The surrounding skin is healthy, though an areola of dusky redness may immediately encircle them. On healing, they leave a bluish-white, semi-translucent, slightly depressed cicatrix, which is apt to break down on slight provocation. Several of these ulcers frequently coalesce, giving rise to a serpiginous or annular form of ulceration, which is very characteristic of syphilis.

B. *The deep ulcers* are nearly always due to the breaking down of gummata. They may occur in any part of the body,

but are most frequently met with in the lower extremities, in the neighbourhood of the large joints, and about the palate and fauces. They begin as deep-seated swellings, which at first are hard and painless, and unattended with signs of inflammation; then central softening occurs, the skin over them becomes inflamed and gives way, a slough separates, and the ulcers are produced. The ulcers are circular or oval in shape, of moderate dimensions, surrounded by a dusky red areola, but by only slight induration; they are generally painless; their edges are sharp-cut, steep, often slightly overhanging or scooped out, and of a dull red colour. The centre of the ulcer is at first occupied by a yellow slough, intermixed with shreds of the breaking-down tissues. On its separation, the base appears considerably below the surrounding skin, but rapidly fills up with granulations under appropriate treatment, the resulting cicatrix remaining slightly depressed, of a smooth, polished, and white appearance, while the skin immediately around is more or less pigmented. Two or more ulcers are frequently present at the same time, one perhaps open and discharging, another in a stage less advanced, whilst there may be several gummata around not yet broken down; and cicatrices of former ulcers are often to be found in the near neighbourhood, or perhaps in a different part of the body.

Treatment.—Iodide of potassium in full doses, combined with quinine, bark, &c., should be administered internally; whilst locally a poultice should be applied till the scab or slough has separated; and afterwards, the red oxide of mercury ointment, or the black wash, or iodoform powder should be used. Where the gummata are not broken down they should on no account be opened, as, even after softening has occurred, they may completely clear up under the influence of the iodide. Inflammation, if present, should be subdued previously to beginning the specific treatment. See SYPHILIS.

Lupoid Ulcers are such as are produced by the softening and breaking down of lupoid tubercles. Lupoid ulcers are most commonly met with on the face, especially about the alæ of the nose. When first formed, their characters, with regard to shape, size, and number, will depend upon those of the lupoid tubercles that precede them. But as the ulcers extend they become confluent, and, spreading superficially, may destroy large portions of skin. They sometimes extend deeply as well, eroding

the cartilages and even the bones, and producing great deformity. The edges of the ulcer are slightly elevated, irregular, eaten out or sharp-cut, and neither inverted nor everted; the base is slightly depressed and raw, granulations being either absent or spongy and prominent, or it may be covered by a scab of hardened secretion. Tubercles that have not yet undergone softening may be seen in the skin around, whilst depressed white cicatrices, produced by the healing of former ulcers, are often present in the near neighbourhood.

Diagnosis.—Lupoid ulcers have to be distinguished from impetigo, from tertiary syphilitic, strumous, and rodent ulcers, and from epithelioma. When the lupoid ulcer is covered with scabs, it may bear a resemblance to impetigo; but the latter affection may be distinguished by its beginning as a pustular eruption, by the absence of tubercles around, by its evanescent character, by the thick yellow characteristic crusts, and by the absence, on removing them, of the ulcerated and spongy surface beneath, as seen in lupus. From ulcers occurring in the course of tubercular syphilides (the so-called syphilitic lupus), it is often very difficult to make a diagnosis. The age at which the disease began, its history and duration, the presence or absence of concomitant signs of syphilis, and the effect of antisyphilitic remedies will help in the determination of the point. The age of the patient is an important factor in distinguishing lupus from rodent ulcer and epithelioma, as both of these latter affections are very rare before fifty. Both may further be distinguished from lupus by the absence of tubercles around, by being single, and by showing generally no tendency to contract and heal. In epithelioma, moreover, the edges are indurated and everted, and the glands are enlarged at an early date of the disease.

Treatment.—The lupous tissue should be thoroughly destroyed either by scraping the surface of the ulcer with a Volkmann's or Morris's spoon till healthy tissue is reached, or by cauterising the parts with the actual or galvanic cautery. Internally, cod-liver oil and arsenic will be found the most useful remedies. See LUPUS.

Rodent Ulcer, although now almost universally regarded as a form of carcinoma, is here described separately, as, whatever its pathological relations, its clinical characters differ in many marked respects from those of ordinary carcinoma. Thus it is much slower in its growth, in some cases having been known to be in progress for

upwards of thirty years. It does not become disseminated, nor, like epithelioma, affect the neighbouring lymphatic glands; nor does it return after complete removal. The patients often enjoy excellent general health throughout its course, attain old age, and appear, except for its local ravages, to be none the worse for its presence. Still, like carcinoma, it is progressively destructive, spreading by infiltration of the surrounding tissues, and sparing neither cartilage, bone, nor other tissue in its neighbourhood; and finally, like it, destroying life. See CARCINOMA.

Symptoms.—Rodent ulcer is a disease of advanced life, seldom occurring under the age of fifty. Its favourite seat is the face, especially about the internal and external canthus of the eyelids and the alæ of the nose, and the scalp. It generally begins as a warty elevation of the skin, of a reddish-brown colour. This, after undergoing several desquamations, finally breaks down into an ulcer. The ulcer is generally single; its edges are irregular, sinuous, a little raised, and but very slightly if at all indurated. The skin around is supple and healthy; the base is slightly depressed, void of granulations, glazed, sometimes furrowed, and of a whitish or pale pink colour; the discharge is scanty and generally thin, though sometimes, especially when astringent lotions have been applied, it may harden, forming variously coloured crusts. Imperfect attempts at cicatrisation are sometimes seen, but no contraction of the part follows, and the ulceration soon again proceeds. It may continue superficial, but spread widely, or it may extend deeply, eating away and destroying everything—muscles, cartilages, bones—in its vicinity, and producing horrible deformity. Thus, a deep, gaping chasm, sometimes involving a part or the whole of one side of the face, may be left; the globe of the eye, perhaps, being destroyed, and the nasal cavities laid open to view. Or the cranium may be perforated, and the dura mater or even the brain exposed.

Diagnosis.—Rodent ulcer may sometimes have to be distinguished from epithelioma, lupus, or syphilis. From epithelioma it may be diagnosed by the absence of induration around, the non-involvement of the lymphatic glands, and its slower growth; but often in their early stages it may be impossible to distinguish these affections. From lupus it may be known by the absence of tubercles around and of cicatricial scarring, and by its beginning in the old, whereas lupus begins in the young.

From syphilis it may be known by the rate of growth, the absence of concomitant signs of the latter affection, and the effect of remedies.

Pathology.—When the edges of the ulcer are examined microscopically, they are found to be infiltrated with a new growth; but the ulceration follows so quickly on the infiltration that, except just beyond the edge of the ulcer, the tissues are healthy. The cells are smaller than those of epithelioma, but are contained in alveolar spaces like those of carcinoma. Cell-nests, but ill-formed and not traceable to ingrowths of the epithelium, are said to have been here and there discovered. The manner in which the growth begins has not for certainty been ascertained, but it appears, from recent researches, to start as a proliferation of the sweat-glands or hair-follicles.

Treatment.—Early and wide extirpation by means of the knife should always be undertaken, and if any doubt exists as to whether the whole of the disease has been removed, the parts should be further destroyed by caustic or by the actual or galvanic cautery. When extensive ravages have occurred, much may still often be accomplished by the knife; and although a fearful chasm may be left—the globe of the eye perhaps extirpated, and the greater part of one side of the face cut away—if the whole of the disease has been removed, the parts may then, to a great extent, granulate up, and the deformity be in some measure obviated by the patient wearing a vulcanite mask, shaped to the lost features and coloured to the complexion.

Epitheliomatous Ulcer.—The general pathology of epithelioma is given under CARCINOMA. The epithelial ulcer may begin as a crack or fissure at the junction of the skin and mucous membrane, or as a wart or pimple on the skin, or it may occur in the seat of an old scar, or in an ulcer that has continued open and discharging for a long period. It is characterised by its irregular, sinuous, raised, everted, and indurated edges; by its indurated base, which is generally raised, and covered with a scab or with warty or proliferating and cauliflower-like granulations; by its thin, ichorous, and sometimes sanious discharge; by the evident infiltration of the surrounding tissues with the new growth; and, after it has existed some time, by the enlargement of the neighbouring lymphatic glands. As the ulcer progresses it gradually invades the surrounding tissues, destroying fat, muscle, cartilage, and bone; the enlarged lymphatic glands soften and break down,

the skin over them gives way, and a secondary ulcer, with characters similar to those of the primary, is produced. Remoter glands may next become affected, but the disease, unlike the other forms of carcinoma, does not, as a rule, become disseminated through internal organs.

Diagnosis.—The induration of the edges and base of the ulcer, the advanced age of the patient, the rapid growth of the disease, the warty or proliferating character of the granulations, the evident presence of a new growth, and the infiltration of the lymphatic glands, are signs which will serve to distinguish an epitheliomatous ulcer from the other forms above described. A microscopical examination of a scraping of the growth will often assist in the diagnosis.

Treatment.—Free and early extirpation is the only treatment of any avail, and should always be resorted to when there is a fair probability of getting away the whole of the disease. A moderate enlargement of the neighbouring lymphatic glands does not, in the writer's opinion, contra-indicate the operation, and any such glands should, if consistent with safety, always be removed at the same time.

W. J. WALSHAM.

ULNA, Dislocation of the.—The upper extremity of this bone has, in very rare cases, been found dislocated backwards, whilst the radius retained its normal position. The writer has once had an opportunity of examining this dislocation. The forearm was semiflexed and strongly pronated, and the olecranon formed an unmistakable prominence behind the elbow. The hand inclined to the ulnar side, and the measurement from the internal condyle to the pisiform bone was half an inch shorter than the same measurement on the other arm. Movements caused great pain, but the head of the radius could be felt in its normal relation to the humerus, on attempting supination. This dislocation is sometimes associated with partial displacement of the radius forwards. Under chloroform, extension from the ulnar side is not likely to fail; but in a case reported by Waterman, straightening of the arm was found necessary, whilst, in one related by Pirrie, sudden flexion combined with pressure on the olecranon proved successful after extension by assistants. (Dislocations at the lower radio-ulnar joint, which some authors describe as dislocations of the lower end of the ulna, will be found under WRIST).

R. CLEMENT LUCAS.

ULNA, Fractures of the.—The *olecranon* may be fractured by falls on the elbow—its most common cause; by direct violence, as by a blow; and, as recorded instances appear to show, occasionally by the action of the triceps. The size of the portion detached varies from a thin plate to the whole of the process. The fragment is drawn up at the back of the joint, sometimes slightly, sometimes for an inch and a half, so that an interval—much increased when the arm is bent—can be readily felt; it can be moved from side to side, and the power of extending the forearm is much impaired. The joint is more or less distended with fluid. Union is generally ligamentous.

Treatment.—The arm must be placed in the extended position on a splint—best applied to the anterior aspect—and the inflammatory swelling usually present must be reduced by rest, position, and cold lotion. As soon as practicable, an attempt should be made to bring the fragment down towards the remainder of the bone. This may be done, either by a figure-of-eight bandage passing above the fragment and round the forearm; or, by placing two pieces of narrow bandage lengthwise, one on the inner and one on the outer side of the joint, crossing them with two or three turns of bandage above and below the elbow, and then tying the upper and the lower ends of each together. These methods, however, are not very efficient, and they, moreover, tend to produce swelling of the joint by constriction. A better plan is to use a loop of narrow elastic bandage, the middle of which arches over the fragment, while its two ends are fastened, one to the inner and the other to the outer border of the splint, at a convenient distance below the elbow, to secure the requisite amount of downward tension; or the fragments may be wired together, as recommended by Sir J. Lister. This operation, however, although it is no doubt free from any considerable risk, is, in the opinion of the great majority of surgeons, not warranted by the necessities of the case, since short ligamentous union, attended with only very slight impairment of the functions of the limb, can be obtained without operative interference. Some surgeons trust entirely to the natural contraction of healing, and keep the elbow bent and the forearm in a sling, with very good results.

Fracture of the *coronoid process*, though a very rare accident, and one which has often been diagnosed when it did not exist, has several times been verified on dissection. Generally, it is produced by falls on the

hand, and is associated with dislocation of the forearm backwards. The injury may be recognised by the fact that dislocation is reduced by slight force, but recurs when extension ceases. Possibly, the detached pieces may be felt in front of the elbow, and crepitus may be present. The brachialis anticus, however, is attached to the base of the process, so as to overlap it towards its apex in such a way that wide separation, unless the muscle itself is torn away, can hardly occur.

Treatment.—The forearm should be flexed upon the chest and confined in a sling. For the management of relapsing dislocation of the elbow, *see* ELBOW-JOINT, Dislocations of the.

Fracture of the *shaft of the ulna* alone is rare, and is always the result of direct violence. The upper third is so strong that it seldom gives way, but the middle and lower portions are sometimes broken in falls over some projecting object or by a blow. There is usually but little displacement; the injury, however, is plainly indicated by mobility, detected by fixing the upper, and pressing the lower fragment towards the radius, or by moving the pieces on each other, by crepitus, and by irregularity of the bone when its subcutaneous ridge is traced down.

Treatment.—As the bone is well supported by the radius, and displacement is usually slight, it is sufficient to apply a pair of straight splints, one on the dorsal and one on the palmar aspect of the limb, and to place the forearm in a sling in the semi-prone position; or gutta-percha or leather splints moulded on the limb, or a light case of plaster of Paris may be used, instead of the straight splints. But should there be any tendency of the lower fragment to start towards the radius, it is better to use the straight splints, with the addition of a narrow pad carefully adjusted over the space between the bones; and the forearm should be placed in a position of supination. The splints may be discontinued at the end of the month; the arm, however, being kept a few days longer in a sling. Passive movement for supination and pronation should at the same time be carefully employed.

HOWARD MARSH.

ULNAR ARTERY.—I. *In the Forearm.*—The artery commences one inch below the elbow—i.e. opposite the neck of the radius—passing obliquely inwards for a short distance, it then runs down the forearm parallel to a line drawn from the front of the internal condyle of the humerus to the outer side of the pisiform bone.

In the *upper* half the artery passes between the superficial and deep layers of muscles; it has superficial to it skin, superficial fascia with the internal cutaneous nerve and ulnar veins, deep fascia, pronator radii teres, flexor carpi radialis, palmaris longus and flexor sublimis muscles; the median nerve crosses it three-quarters of an inch below its commencement, passing from within outwards. The artery rests on the flexor profundus digitorum. In the *lower* half of the forearm the artery is covered only by cutaneous structures, and it rests on the same muscle; it has the flexor carpi ulnaris tendon to its inner side, serving as a guide, and the flexor sublimis externally; the ulnar nerve lies on its inner side.

LIGATION.—1. In the middle of the forearm the artery is reached by an incision, two inches long, in the guiding line of the artery. Cut through the cutaneous structures; in opening the deep fascia, recognise the outer tendinous edge of the flexor carpi ulnaris, enter between the sublimis externally and this tendon internally, and find the ulnar nerve or artery. If between the ulnaris tendon internally and the sublimis externally the nerve is seen, the artery, with its veins, will be to its radial side.

2. In the lower third the artery is exposed by an incision commencing in the guiding line two inches above the wrist, and ending half an inch above the pisiform bone. The outer edge of the ulnar tendon again serves as a guide, especially after the cutaneous incision is made. It is drawn inwards, when the artery is found lying beneath a process of the deep fascia, with the ulnar nerve to its inside, the flexor sublimis to its outside, and, behind, the flexor profundus digitorum.

II. *In the Hand.*—The ulnar artery passes from the outer side of the pisiform bone across the palm of the hand, just below the crease of the thumb muscles—the line of life—forming with the superficialis volæ from the radial, the superficial palmar arch. When the ulnar artery is clear of the pisiform bone, it sends down a deep branch to complete the deep palmar arch by joining with the radial trunk. The superficial palmar arch sends downwards digital arteries towards the clefts between the fingers, where, opposite the heads of the metacarpal bones, each vessel divides to supply the fingers, passing along their lateral aspects. The arch lies beneath the palmar fascia, and upon the median nerve and the sublimis tendons. The deep arch lies upon the bases of the metacarpal bones.

JAMES CANTLIE.

UMBILICAL FISTULA may result from one of three causes, the first two of which are congenital. (1) It may result from non-closure of the urachus, or (2) from continued patency of the omphalo-mesenteric duct. (3) It may arise from the opening of an abscess in some part of the abdominal cavity.

1. The urachus, which forms in early foetal life a tubular communication between the bladder and the allantoic vesicle, and should become closed long before birth, remains occasionally patent, and it then gives passage to small quantities of urine, and has been known to remain unclosed until late in life. Besides the flow of urine from within, materials from without sometimes pass into the channel, and are then liable to become nuclei, around which concretions and deposits from the urine will collect and give rise to considerable trouble and inconvenience. In general, the permanence of such opening is marked by the occasional and inconstant issue of urine, and as a consequence of this, some eczematous eruption may be found at and around the navel. Spontaneous closure may take place after birth, but when it does not, and when the inconvenience and suffering is sufficient to render operative measures necessary for the closure of the opening, a light touch of the actual (or Paquelin's) cautery, or of a galvano-caustic wire, followed by careful strapping together of the granulating surfaces, is all that is requisite to effect their union. In some instances a mass of granulations is seen to arise from the umbilicus and to constitute a tumour, which attains in some instances a length of nearly an inch; and in the centre of this there may often be seen a small channel, from which issues a frequent discharge of fluid, having the characters of urine. The granulations are merely a result of irritation, and are directly due to the permanence of this condition. A ligature, tied firmly round its base, will strangulate the tumour, and the treatment above recommended will close the canal if it still persists.

2. Although very rarely, instances are occasionally met with, in which there remains a congenital communication between the umbilicus and some part of the intestinal tube by means of the omphalo-mesenteric duct, which, though often obliterated, can not infrequently be detected at post-mortem examinations as a diverticulum running upwards from the lower part of the ileum, and attached at the umbilicus. Through this canal, when patent, discharges having a faecal odour will exude, and some-

times even small quantities of the ingesta can be detected in the fluid that issues. The treatment recommended above may be applied in such cases, or the edges may be pared and brought together by stitches.

3. By far the most usual cause, however, of this form of fistula, occurs in children with a tendency to a tubercular diathesis, and is due to the opening of an abscess at the umbilicus, which, in most instances, is the result of suppuration in the glands of the mesentery, either from breaking down of tubercular deposits, or secondary to some inflammation or ulceration of the intestines. This form, therefore, is never of congenital origin, and the discharge is more distinctly purulent, and when mixed, as it not infrequently is, with faecal matter, points to the existence of a communication with the cavity of the intestine. There would seem to be a natural tendency for such accumulations of matter to make their way towards, and to present at, the umbilicus, although no good anatomical reason can be given for their taking this direction. When once the abscess has burst, the sinus which follows is lined with healthy granulations, and can be traced for some distance into the abdomen by means of a probe, and the external aperture is occasionally large enough to admit the tip of the little finger. The presence of bile in the discharges may indicate a connection with the liver or its ducts, but no such communication has ever been demonstrated by dissection. These fistulae are very difficult to close; sometimes they will heal spontaneously after a considerable lapse of time, if the patient is kept quiet in bed; in other instances they will heal after adoption of some such methods as are mentioned above; but it is often necessary that the sinus should be laid open, and this is best done by passing down a probe-pointed bistoury as far as is deemed safe and cutting outwards, the wound being dressed antiseptically, and allowed to heal from its deepest part. See *Faecal Fistula*, under *Faecal Abscess*.

JOHN H. MORGAN.

UMBILICAL HERNIA. — Ruptures at the umbilical cicatrix are of three kinds: 1. The congenital. 2. The infantile. 3. The adult form.

1. *The congenital*. These herniae are very rare, and exist at the time of birth. They are due to an arrest of foetal development, whereby the abdominal cavity remains imperfectly closed in the region of the umbilicus. Some of these herniae are

of enormous size, and contain nearly all the abdominal viscera. They occur in monsters, and are associated with other deformities not consistent with life. As a rule, the protrusion is small, and is in the substance of the cord. The tissues of the cord are stretched over the sac, with which these herniæ are always provided, and the umbilical vessels are separated by it. The rupture appears as a rounded or conical swelling at the point of attachment of the umbilical cord to the abdomen. The coverings of the hernia may be so thin that the contained gut can be seen through them. Or the coverings may be absent, or may become ruptured soon after birth, and allow the viscera to escape. The contents are usually small intestine, and very often the cæcum. In some instances, the hernia and its contents have unwittingly been cut across in dividing the cord at birth. In many instances the hernia has undergone spontaneous cure. In any case the rupture should be reduced, and retained by broad strips of strapping passed round the abdomen.

2. The infantile form is very common. It depends upon yielding of an imperfectly consolidated umbilical cicatrix, and is most frequently met with during the first year of life. The swelling is usually small, and gives no trouble. So far as the writer is aware, it is never the seat of strangulation. Beyond certain moderate limits the hernia shows no tendency to increase. If left alone these ruptures will, in nearly every instance, undergo spontaneous cure. If any treatment be required, the hernia should be reduced, and the edges of the hernial orifice carefully held together by the forefinger and thumb. The margins of the opening should then be maintained in this position by means of strips of strapping passed across the abdomen. There is a form of treatment which is to be condemned, if on no other ground than that it prevents the cure of the rupture, and tends to perpetuate it indefinitely. It takes the form of an elastic belt, to the inner aspect of which a small button or nodule is affixed. This button is supposed to fit into the hernial orifice, and while it occupies that position it merely keeps the abnormal orifice patent, and prevents its closure. Fortunately, the button soon slips out of place, and no harm is done, except such as may be occasioned by the wearing of a tight abdominal band.

3. The adult form. The umbilical hernia of adults may—as a rare circumstance—have persisted from infancy. The great majority, however, are newly formed in adult life. This hernia is more common in

women than in men, is most common in those who are obese and have large and pendulous abdomens, and especially in women who have borne many children. The average size of the rupture is about that of the closed fist. It may, however, attain large dimensions. As it increases in size it becomes pendulous, and may in time reach the groin. The hernia is always provided with a sac. The tumour is often irregularly lobulated, and its coverings are frequently very thin. The contents of the protrusion are most usually the great omentum, the transverse colon, the small intestine. It may contain the stomach, and even the cæcum. It often presents what is known as an omental sac.

This hernia is often irreducible in whole or in part. It is sometimes inflamed; it is but rarely strangulated; it is peculiarly prone to become obstructed or incarcerated. When reducible, it should be retained by a suitable abdominal belt. The introduction of a small pad of cork in the front of these belts is objectionable. The pad occupies the hernial orifice, and tends to maintain, if not to increase, its dimensions. When irreducible, the rupture should be protected and supported by a proper belt, the precise arrangement of which will vary according to the size and outline of the rupture, and the condition of the abdominal walls.

When the hernia is strangulated, it may often be reduced by taxis, the pressure being applied in a direction directly backwards. When herniotomy is required, a vertical incision of about two inches in length is made in the middle line at the upper part of the tumour. One half of this incision should fall upon the tumour, and the other half upon the abdominal parietes. The risk of cutting into the sac is much diminished by making the incision from below upwards, thus commencing it upon the tumour. The stricture will be at the opening in the parietes; and it should be divided by cutting directly upwards in the middle line. When possible, the rupture should be reduced without opening the sac. After the hernia has been reduced, the edges of the hernial orifice should be carefully brought together by several points of catgut suture. The sac may then be excised close to the hernial aperture, and its cut edges neatly brought together by sutures which maintain its serous surfaces in contact. When the hernial orifice is very large, it may be necessary to use harelip-pins to effect a closure. In such a case the pins should be removed at the end of forty-eight hours. **FREDERICK TREVES.**

UMBILICUS or NAVEL.—The umbilicus is more frequently spoken of as an anatomical point, than as the seat of any peculiar diseases. It is situate in the middle line of the abdomen, a little below midway between the ensiform cartilage and the symphysis pubis, and marks the point of separation of the two recti, which admits the entrance of the contents of the umbilical cord, and forms the point of their attachment subsequently to foetal life. These are the umbilical arteries and vein, and the urachus, which are enclosed, within the abdomen, in a fold of the parietal peritoneum. It corresponds in situation to the body of the third lumbar vertebra, and the spot at which the aorta is most easily compressed is about an inch below and a little to the left of the umbilicus. It is below the umbilicus that the usual incision in the median line commences in laparotomy for intestinal obstruction, or in operations for the removal of tumours of the uterus or ovaries; and the cases are rare in which it needs to be carried above this spot, but when this has become necessary, the abdominal walls should be divided with blunt-pointed scissors, and the incision be carried round, but never through, the umbilicus. Other operations, either for removal of tumours of abdominal organs, or for other purposes, may commence above the umbilicus, but the same rule must apply in extending them downwards. In a healthy state, the rudiments of the cord dwindle after birth, and a firm cicatrix is formed; but it sometimes happens that when a ligature has been placed on the cord, the portion nearest to the infant does not wither, and is converted into a granulating mass which requires a fresh ligature to be placed round its base, or the application of a piece of solid nitrate of silver, before it dwindles to its normal condition. *See UMBILICAL FISTULA.*

Hæmorrhage sometimes occurs in newly-born infants from careless ligature of the cord, or from the ligatured portion being torn off before the vessels are properly closed. This is seldom of much consequence, and is to be arrested by replacing the ligature. But a much more formidable hæmorrhage, or rather a constant oozing of blood from the granulating surface of the navel, sometimes takes place soon after birth, and this is either due to the hæmorrhagic diathesis, or it is found to be associated with a congenital malformation of the cystic or hepatic biliary ducts, or to the absence of a gall-bladder. Such bleeding is not restrained by styptics or even by

ligature, owing to the absence of any coagulating power in the blood; and although when associated with these deformities, there is invariably a fatal termination, yet it is necessary to check the hæmorrhage, which can only be done by passing harelip-pins through the integuments, and constricting the parts with a piece of silk tied round their ends. The condition often occurs in several children of the same parents. Fatal cases of pyæmia in infants, with multiple abscesses and destructive inflammation of various joints, have sometimes been ascribed to inflammation of the umbilical vein.

In very stout persons a deep transverse depression often exists, running across the abdomen and completely obscuring the navel from view. This furrow frequently becomes the seat of a troublesome eczematous eruption, which goes on to ulceration if the affection is not speedily relieved. The variety is known as eczema intertrigo, and is one which is especially liable to affect fat subjects. It arises from decomposing secretions (sweat, &c.), being confined in moist and warm situations, and is characterised by an angry erythematous blush, associated with sodden epidermis and fetid exudation. The treatment consists in thoroughly separating the parts and cleansing with oatmeal and warm water, after which rags soaked in an astringent lead lotion should be applied for some hours, and finally a desiccant powder should be dusted on and some soft absorbent material employed to separate the parts. A saline aperient should be given at the same time.

Other forms of ulceration may affect this region, particularly those occurring in the third stage of syphilis, and a Hunterian chancre may sometimes be detected. Psoriasis, whether simple or syphilitic, causes great irritation, when by reason of folds of fat there is accumulation of acid secretion on surfaces denuded of epithelium. So too scabies finds a convenient nidus in this situation, and will often give rise to the greatest discomfort. Epithelial cancer is seen sometimes to arise idiopathically from the umbilicus, and commences as a superficial ulcer, resembling an excoriation and dipping into the pit of the navel or occupying the summit of the prominent button at the bottom.

Umbilical hernia or ruptured navel occurs in infants and is very common. The contained viscus, which is usually part of the small intestine, but which may be the stomach, omentum, large intestine, or bladder, pushes forward a portion of the parietal

peritoneum through the lax tissues which surround the umbilical vessels at their attachment in the linea alba. The coverings are therefore very thin and the diagnostic symptoms are those of hernia generally (see HERNIA). A small round tumour is present, easily reduced by the pressure of the fingers, and the sharp tendinous edges of the aperture can then be felt. It seldom becomes large, except when conjoined, as it sometimes may be, with a ventral hernia, produced through non-closure of the recti above or below the navel. In all cases it has a tendency to natural cure, so much so that umbilical hernia is almost unknown in youth, and the only remedy which the surgeon is called upon to prescribe is a flat pad of cork, or of metal, covered with wash-leather, and secured by strapping or by an elastic band which laces behind. Some surgeons have, however, thought fit to operate in these cases.

The form of umbilical hernia which occurs in adult life is a protrusion which arises at one side of the navel proper, generally in the middle line above it, and is found in elderly persons, more commonly in stout females. The viscus, whether intestine or omentum, pushes forward the fibrous structures which are relaxed in consequence either of frequent pregnancies or of general fatty degeneration. It has a tendency to increase in size, and is not unfrequently irreducible, owing to the formation of adhesions. When this form of hernia becomes the seat of strangulation operative interference is not always called for, as the symptoms will often subside after the active use of enemata, &c.; but when it becomes imperative to use the knife the issue is frequently unfavourable, on account of the general unhealthy condition of such patients. A carefully constructed truss must be constantly worn. JOHN H. MORGAN.

UNREDUCED DISLOCATIONS. See DISLOCATIONS.

UNUNITED FRACTURE. — True ununited fractures are rare; but some delay in the process of union, especially where the fracture has been inefficiently treated, is not uncommonly met with. No hard and fast line can be drawn between the two classes of cases: the union of such a bone as the femur may be delayed many months—in one recorded case for as many as twenty-two—and yet eventually take place without operative treatment. It is difficult, therefore, to say at what exact time a case of delayed union becomes one

of ununited fracture. Whatever induces delay in the union of a fracture may also, if the same conditions continue to exist, lead to permanent non-union.

The great majority of cases of ununited fracture depend on some *local* cause. The fracture has been badly set, the fragments have never been in good apposition, with perhaps some foreign body, some piece of muscle or other soft tissue, between them: or, originally together, the splints over them have been too tightly or too loosely applied, producing in the former case obstruction to the circulation and consequent delay in the deposit of reparative material, allowing in the latter harmful mobility. An over-anxious surgeon, who is perpetually meddling with a fracture, may get delay or even non-union for his pains; and restlessness and intractability, on the part of the patient, will predispose to the same result. Injury to the nutrient artery, or to the main vein of a limb, with resulting phlebitis and thrombosis, may be mentioned amongst the local causes of delayed and non-union, as also may disease of the fractured bone itself. Of this, necrosis is the most common example, and it is nearly always in cases of compound fracture that it is met with, either following comminution of the bone or detachment of its periosteum. In very rare instances, small detached portions of bone, embedded in the callus, necrose at a later period and cause disunion. In the London museums are five preparations showing non-union from mollities ossium, one from atrophy, one from fragilitas ossium, and one, in a lion's bone, from rickets. Cases of non-union are mentioned by Norris, in which bones affected with chronic abscess, hydatid cyst, and nodes, have given way at the seat of disease. The too early removal of splints, especially in oblique fractures of the lower extremity, where the weight of the body is thus prematurely brought to bear on imperfectly ossified callus, may lead to the absorption of that already laid down, or prevent its further development. Sometimes, a congenital ununited fracture is met with.

Most *constitutional* causes, such as fevers, scurvy, syphilis, privation, sudden changes of diet—e.g. deprivation of accustomed alcohol—pregnancy, lactation, hæmorrhages, delay rather than permanently arrest the union of a broken bone. Alkaline urine, with an excess of phosphates, is found sometimes to be present where no other cause for the non-union can be ascertained to exist, or it may accompany one

of the above conditions. What influence the nervous system exercises over the union of fractures is uncertain. Cases of natural union in paralytic limbs have been recorded; but in one case of fracture of the lumbar spine, in which both the arm and the leg were broken, only the humerus united. Spontaneous fractures of ataxia reunite readily and rapidly, with an enormous formation of callus. The bones of lunatics seem to be more brittle than normal and break easily, but, unless there is some disease such as *mollities ossium*, they unite with readiness. Experiment has shown that division of the nerves of a limb has the effect of making the callus of a fracture, on that side, larger and harder than in one on the opposite side.

It is usual to classify cases of non-union under three heads: fibrous union, false joint, and absolute non-union. Fractures of certain bones—the patella, olecranon, neck of the femur (when intracapsular) and coronoid process—so usually unite by fibrous tissue, that, when in this condition, they can hardly be regarded as instances of ununited fracture.

Fibrous or ligamentous union, as it is sometimes called, may be effected by one or more bands, usually the former. The fibrous tissue appears to be the result of an arrest of the process of union, just when ossification should commence. Sometimes masses of bone are embedded in it; these are either comminuted fragments which have become encysted, or the result of limited ossification from separate centres. The neighbouring periosteum is often thickened, and other fibrous bands connecting the fragments may be formed by atrophied muscular tissue or interosseous membrane. The ends of the bone, in cases of long standing, are usually coated with fibrous tissue, somewhat atrophied, rounded off, and pointed; in other cases they are found enlarged and sclerosed, with, perhaps, irregular masses of callus around them. The medullary canal is usually filled in with an osseous or soft fibrous deposit, but may be patent from atrophy. In cases of *false joint* the ends of the bone are often expanded, eburnated, or covered with fibrous, cartilaginous, or fibro-cartilaginous material, one, perhaps, convex, fitting into the concavity of the other, and surrounded either by a proper fibrous capsule—a sort of unossified provisional callus—or by a capsule formed by the neighbouring soft parts. The interior of this capsule may be smooth or fasciculated, is often moistened by a synovia-like secretion, and sometimes contains

loose bodies or has soft outgrowths projecting into its cavity. When the ends are more widely separated, a bursal sac, which does not enclose them, may be interposed. It is only in rare instances that the surgeon has to do with *absolute non-union*. The bones in such a case are atrophied; the limb generally shrunken, wasted, and useless; movement of the fragments is very free, and not imparted from one to the other.

The *diagnosis* of ununited fracture is easy. If in the lower limb, the patient either cannot walk at all, or, if able to do so, is aware of a sensation of 'giving' at the seat of fracture when the weight of the body is brought to bear on it. In the upper limb, the arm is more or less useless and perhaps flail-like; if the forearm is affected, there will probably be loss of the power of pronation and supination. There is frequently deformity at the seat of non-union, and the surgeon can, by manipulation, move one fragment on the other. The extent of this movement will depend much on the displacement of the fragments, the interval separating, and the consequent length of the uniting material between them. Very rarely, the fragments are so interlocked that there is but little impairment of the function of the part. Whether a case is one of fibrous union or of false joint must often remain a matter of doubt. Fibrous union is the more common, allows, perhaps, of greater movement, and is unattended by the crepitus that occasionally is met with in cases of false joint. If manipulation causes much pain, the uniting medium is said to be probably fibro-cartilaginous. In such cases union is probably only delayed, and they have a good prognosis.

Treatment.—It should be remembered that the union of some fractures is necessarily slow—e.g. where there is much displacement or great obliquity of the fragments; in such cases, patience and perseverance in the original treatment will probably be all that is required. Whenever any of the causes of delayed union enumerated above are present, the surgeon must at once direct his attention to its removal. A patient with scurvy must have fresh vegetables, fresh meat, and lime-juice; one with syphilis a course of mercury, iron, or potassium iodide, according as one or the other is indicated; one who is cachectic, weak, has undergone privation, or suffered from hæmorrhage, a generous diet and tonics; one accustomed to stimulants, beer and wine; a suckling woman must wean her child; a pregnant one may be assured

that, after delivery, her fracture will probably unite; a phosphatic and alkaline condition of the urine is best treated by a liberal diet and dilute mineral acids. Some of the local causes of delayed union, such as injury to the nutrient artery, are beyond the surgeon's control, but most can be avoided by careful treatment. If crepitus is elicited when the fracture is set, it is improbable that any foreign body, muscle, or other piece of soft tissue is between the fragments. Efficient application of splints and careful after-treatment should prevent either undue mobility or too rigid confinement of the fracture; if this has been oblique or there has been much displacement, extra time must elapse before the support afforded by splints is finally dispensed with. Necrosed pieces of bone, if not separating naturally, must be removed by operation. In neglected cases of fracture, where the delayed union is simply due to separation of the fragments, the surgeon, if the injury be at all recent, may by the use of continuous extension be able to a great extent to rectify the malposition, and so bring the parts into a more favourable condition for union or, failing to obtain this, for any operation that may be needed.

If delayed union follows treatment by splints and absolute rest in bed, the patient should be allowed to get up and go about in the open air with his fracture put up in a plaster of Paris, silicate of potash, leather, or pasteboard splint. In this way, the ends of the bone being rubbed together, the parts are excited to greater action and union may result. If the patient has already—from the first—been treated by the plaster of Paris bandage or some such immovable apparatus, it may be that a change to splints and rest in bed will procure consolidation. Frictions, shampooing, stimulating embrocations, or even blisters or issues over the seat of fracture, may also be tried. Mercury—even in non-syphilitic subjects—is sometimes given empirically. If after a reasonable time no union results, the case must be regarded as one of ununited fracture, and more severe measures will be necessary. Amongst the many operations that have been devised are the following:—

Dieffenbach's operation of drilling the bones and inserting ivory pegs into them. The pegs may be cut off level with the bone and allowed to remain, and often give rise to no irritation, or they may be removed at a subsequent operation. Some surgeons have used copper nails for the same purpose. *The introduction of gilt steel needles* into

the bones under antiseptic precautions, has in Germany met with a good result. The needles are ten or twelve in number, and are retained for fifteen days.

Irritation of the unossified callus by *acupuncture*, or *subcutaneous incision* by means of a narrow-bladed tenotome, has also been practised. In performing such an operation, it must be remembered that large vessels—even the main artery of the limb—may be close, if not actually adherent to the fragments. *The passage of a seton*, silk or silver wire, between the ends of the bones is attended with the same danger of injuring important vessels or nerves: in some cases, where it is impossible to pass the seton between, it may be passed in the immediate neighbourhood of the fragments. *Drilling the bones* may be practised in many ways. The ends may be perforated in one or more places and the drills withdrawn; they may be left *in situ*, or, in suitable cases, passed right through from one fragment into the other, so as to hold them together. In such cases, the apertures should be made by a circular drill, and into these circular openings other drills, triangular on section, should be introduced, so that there may be thus provided an escape for the discharges. This operation has been practised by Sir J. Lister for ununited fracture of the neck of the femur. External incision may usually be dispensed with; if the bones be at all deeply situated, the insertion of long hare-lip pins may sufficiently mark out their limits and be a guide during the operation.

If, in addition to failure of bony union, there be irremediable displacement of the fragments, in itself sufficient to spoil the utility of the limb (e.g. great inversion of the foot, in a case of fractured leg), such simple operations as the foregoing must give way to the more severe measure of *resection*; and removal of more bone than just the ends of the fragments may be necessary to correct the malposition. Before, however, the displacement is put down as irremediable, it must be clearly seen that it is not due to or kept up by contracted tendons. If it were, tenotomy might make one of the milder operations feasible. Resection will also be needed when, although there is little displacement, other measures have failed, and probably in nearly all cases of false joint. It is now usually combined with wiring the fragments, the wire either being cut off close, hammered down, and left; or being twisted a known number of times, made to project from the wound, and subsequently removed. Since the in-

introduction of antiseptics, this operation is not to be regarded as of much danger when practised on most of the long bones. In the case of the femur, where a large deep wound is made, and much manipulation is perhaps necessary to bring the fragments together, the amount of discharge following the operation is usually so great as rapidly to soak through the dressings and make it a matter of some difficulty to keep the wound thoroughly aseptic; no such trouble is experienced with the other bones. Such resections are not nearly so dangerous as ordinary compound fractures in the same situations. The wound is made with a clean sharp instrument, with antiseptic precautions from the very first, the soft tissues are less injured, and the condition of the bone and medullary canal is usually, from previous pathological changes, such as to render them more tolerant of injury than when in their natural healthy state.

In performing resection it is well to render the limb bloodless, either by elevation or the application of Esmarch's bandage. As a rule only a single incision, if possible passing through a muscular interspace, will be required; but in the forearm, if both bones are implicated, two will be necessary; and sometimes, when the fragments of such a bone as the femur overlap much, and are deeply situated, it will facilitate matters if a separate incision is made on to each of them; the more dependent wound will be useful for drainage. The fragments may be drilled obliquely, or the wire passed through their whole thickness. The former is the easier, but more likely to split the bone; on this account, too, the saw is to be preferred to the cutting pliers for the actual resection. All periosteum should be preserved. In cases where both bones of the forearm or leg are ununited, the two upper or the two lower fragments may be found joined to each other. It is very essential in the forearm to separate and keep them apart, and to remove any redundant callus that might subsequently interfere with the movements of pronation or supination. The after-treatment of cases where resection has been practised resembles that of an ordinary compound fracture.

Nüssbaum's *transplantation of bone*, with antiseptic precautions, may be mentioned as another method of treatment. See *Bone-grafting* under GRAFTING.

Amputation should only be resorted to as a last resource, when other operations have failed and the limb is a useless encumbrance.

Mechanical appliances are most commonly used in ununited fracture of the femur; they may also be advisable for cases where, although resection and wiring has failed, the limb is still, with such a support, more useful than a stump would be, or when the patient objects to or is a bad subject for operation.

The *prognosis* after operations for ununited fracture is better when non-union is due to a local, than when it is due to a constitutional, cause; better, when irregular masses of callus show there has been an attempt at ossification, than when there is no such evidence; and better, when the bones are enlarged and sclerosed, than when they are atrophied.

GEORGE ROBERTSON TURNER.

URÆMIA. — This is a convenient clinical term used to indicate a condition in which peculiar phenomena, chiefly nervous, are exhibited as the result of the retention in the blood of matters usually eliminated by the kidney. These phenomena may either present themselves suddenly with great vividness and be followed by speedy recovery or death; or may come into being slowly, remain but slightly pronounced for a considerable time, and then quietly pass away with complete convalescence; or, on the other hand, become gradually exaggerated until they finally terminate in death. We speak accordingly of acute uræmia and chronic uræmia. The commonest cause for both of these conditions is one or other form of Bright's disease, but they may also be produced by mechanical obstruction, of one variety or another, to the flow of urine from healthy kidneys. In this way, the impaction of stones in the ureter or the pressure on the latter by a tumour may give rise to retention in the blood of those matters capable of producing uræmic symptoms, simply by throwing them back upon the kidney and embarrassing its free action.

The *symptoms* of uræmia are either suddenly developed in most pronounced forms without any warning, or are preceded by certain premonitions of a less distinct character. Among the latter may be mentioned slowing of the pulse and headache of a fixed kind, often referred to the back of the eyes or occiput; heaviness and mental inactivity are also noticed. The patient may also vomit once or twice in the morning without any evidence of dyspepsia, the vomited matter being watery and smelling of ammonia, or may have attacks of diarrhoea, or, again, may complain of dimness

of vision from time to time, which passes off completely. These premonitory symptoms, if they belong to uræmia, are usually followed, sooner or later, by acute evidence of the state of the blood. The most common is convulsions. These are of an epileptic character, and are usually accompanied by complete loss of consciousness, though not always. There is also biting of the tongue and foaming at the mouth. In the majority of cases, coma follows upon these fits and is usually deep, but coma may also appear without any previous nerve-explosion.

Uræmic convulsions may be single, but are more frequently repeated again and again, at shorter or longer intervals. During the stage of coma, the pulse is often quickened, the temperature rises, the teeth are ground, and there are twitchings of the muscles, and the fæces and urine are passed involuntarily. The pupils at the time are usually dilated and do not contract to light, but in some cases they have been found to be contracted or only of normal diameter. The face is usually pale all the time. In the intervals between the attacks the patient may appear quite well, and may recover vision completely, but often the sight of one eye at least remains impaired and the headache persists. The impairment of vision may be due to functional cerebral disturbance, which leaves no change in the eye appreciable by the ophthalmoscope, or may be due to actual changes in the retina, the result of the kidney-disease which leads to the uræmic symptoms. Of these organic changes in the fundus of the eye several are described. Dr. Gowers speaks of—(1) an œdematous swelling of the retina; (2) white patches of degeneration; (3) hæmorrhagic patches; (4) optic neuritis; (5) atrophy of the optic nerve and retina following the latter. Uræmic deafness is also occasionally noticed as a transient symptom, but is not so common as the ocular phenomena just mentioned.

The chronic condition of uræmia differs from the acute in that the fits are not so frequent and violent, and if there is any coma subsequently it is not so deep. Muscular twitchings, headache, itching of the skin, and morning sickness are, however, persistent. If the matters vomited are tested they are found to be of low specific gravity, and of alkaline reaction due to the presence of ammonia. Asthmatic attacks and hiccup are also noticed. The sleep is bad and disturbed by distressing dreams, and vision is frequently deranged.

All this assemblage of symptoms has long been recognised as depending upon the

retention of excrementitious matters in the blood, but the exact nature of the latter and their mode of action have been the subject of much debate. Without going into the details of the controversies on these points, which have been ably handled by Dr. Ralfe, it may be pointed out that one of the earliest views with regard to the causation of uræmic phenomena was that of Christison—that it was due to the accumulation of urea in the blood. This was very soon abandoned in favour of the theory that it was not the urea itself, but the ammonium carbonate derived from its decomposition, which gave rise to the well-known symptoms. But this theory, too, was found to be unsatisfactory, as also that which laid the evil to the credit of an excessive quantity of potassium salts in the blood. Further, it was suggested that uræmic nerve-explosions were due simply to the mechanical effect of œdema of the brain, combined with anæmia brought about by the associated renal disease; but this theory again has not met with general acceptance. From a review of the whole subject, in the light of the most recent investigations, it appears probable, as Dr. Ralfe points out, that so-called uræmic phenomena are not caused by the toxic effects of one substance alone, but by the presence in the tissues of numerous other decomposition-products such as kreatin, leucin, and extractives, which have accumulated there and have actually brought about an alteration in their chemical constitution. He further lays stress upon the fact that in uræmia there is a considerable amount of acid unexcreted, and consequently diminished alkalinity of the blood. The reduced power of oxidation which accompanies this change must react powerfully on the tissues already loaded with decomposition-products, and especially on the nervous system.

The *diagnosis* of uræmia from epilepsy is often not easy unless the history of the case be known, and especially the state of the urine. But, as a rule, the turgidity of the vessels of the face and asphyxial symptoms are less marked in uræmia. From apoplexy the condition is distinguished by the absence of paralysis. In cases of opium-poisoning the coma is continuous; uræmic coma is often interrupted; the pupils, too, are not contracted, as a rule, in the latter condition, and the face is pale, while the breathing is not stertorous and is quiet.

ARTHUR E. BARKER.

UREA, one of the chief results of tissue-metabolism, is consequently found in

those organs and tissues where change is most active, always excepting muscle. Its occurrence and the means of recognising it in urine are the subjects of the following article, but may be fittingly prefaced by a few general observations.

Chemical Composition.—Urea is a prismatically crystalline substance, which, soluble in water, insoluble in alcohol, is easily decomposed by heat, fermentation, &c. On the other hand, it may easily be artificially made, so that its composition is now perfectly understood to be that of an amide, the amide of carbonic oxide, thus $\text{CO} \begin{smallmatrix} \text{NH}_2 \\ \text{NH}_2 \end{smallmatrix}$, which (in the process of fermentation, &c.) is saturated with two molecules of water, the result being its metamorphosis into carbonate of ammonia. It is worth while digressing for a moment to point out here that this katalytic process, of such great practical moment in the surgery of the urinary organs, may follow as a result of three distinct conditions, one of which at least, however, is impossible (so far as we know), *intra vitam*—(1) Prolonged heating in the presence of water; (2) by the action of alkalies (this is comparable to No. (1)—viz. hydration); (3) by far the most important, the action of the so-called micrococcus ureæ, or possibly a product of its growth. See SEPTIC DISEASES, Classification of. It is interesting to note, what has been known for some time now, that this mode of decomposing urea is attended with slight result unless there are phosphates present. This is evidenced by the great difference in behaviour between a pure solution of urea and normal urine.

Relation to Tissue-change.—Urea being a product of metabolism, it now behoves us to consider its origin and practical import, since such must form a valuable aid to diagnosis, other things being equal. In the first place, it is quite fallacious to rest any opinion on an excess or deficit over or below the 'normal' amount passed, unless the two preliminary points—(1) the ingestion of nitrogen as food; (2) the amount of tissue-waste produced by exercise in various ways, pyrexia, &c., be fairly estimated and known. Forewarned in this way, the relation of the amount of urea passed, to the actual degree of tissue-change on the one hand, and the secretory power of the kidneys on the other, (see URINE) is a determinable fact within certain limits. The normal amount of urea passed by a healthy adult male in twenty-four hours varies from 30 to 35 grammes—i.e. from 450 to 525 grains. This amount is, of course, the *average* quantity from day

to day, and is the total quantity excreted in the twenty-four hours. It must not be imagined that the excretion is regular, for examination of the urine at varying periods, between meals and directly after meals, shows that the amount of nitrogen got rid of is doubled according to the period examined.

The well-known increase due to pyrexial processes, &c. (Ringer), need not be referred to here, and for its relation to the excretion of uric acid, see URINE.

Quantitative Estimation.—The possibility of decomposing urea, uric acid, kreatin, &c., the nitrogenous constituents of the urine, by the action of an alkaline hypobromite or hypochlorite, enables the quantitative estimation of the amount of nitrogen excreted to be a comparatively simple matter now; the cumbersome and extremely uncertain method of Liebig being now superseded by the more accurate and more complete process of observing the total quantity of nitrogen in the urine.

The method requires little detailed description. A measured quantity (5 c.c.) of the urine is placed in a small tube or glass bottle, and this is then carefully lowered into a larger bottle, into which 25 c.c. of freshly prepared solution of hypobromite of soda have been previously poured. Without mixing the urine and hypobromite solution, this bottle is then firmly corked with an india-rubber stopper, through the centre of which passes a glass tube. Now, the mixing of the urine with the hypobromite will cause the katalytic destruction of the nitrogenous bodies contained in that fluid, and so produce the evolution of a definite volume of nitrogen. This gas, being led off by the tube perforating the india-rubber cork, can be measured by displacing water in a tube to which it is connected. By previous analysis of known substances this tube can be graduated at once, not merely in divisions which show the amount of nitrogen evolved, but also how much urea that amount of nitrogen represents, in percentages of the total urine. Perhaps the best (being the simplest and accurate) apparatus is that of Gerrard. To repeat: the amount of nitrogen given off by this means, and measured (as is customarily the case) in percentages of urea, represents not only the urea present, but also other bodies referred to above. In regard to the amount of uric acid passed, and its correlatives, carbamic acid and ammonia, it has recently been proposed to estimate these (when in mixture) by the use of sodium hypochlorite followed by sodium hypobromite.

Thus (Fenton): take two equal portions (a) and (b) of the solution, and from (a) measure the amount of nitrogen evolved by action of the hypobromite. Call this amount V_1 . Treat the other portion (b) with the hypochlorite, and let V_2 = volume of nitrogen obtained. Act on the residue of this experiment with the hypobromite, and let V_3 = the volume of N. produced. And if x = vol. of nitrogen due to urea,

$$\begin{aligned} y &= \text{ammonia,} \\ z &= \text{carbamic acid,} \\ \text{then } x + y + z &= V_1, \\ \frac{x}{z} + y &= V_2, \\ z &= V_3. \end{aligned}$$

After discounting the ordinary fallacies mentioned above as attendant on the deduction drawn from the amount of nitrogen excreted in the twenty-four hours, it is perhaps scarcely necessary to state that since the separation of urea by the kidneys, in normal physiological action, is now well known to be a direct process carried on by the epithelium of the convoluted tubules, it is obvious that we have a definite means of ascertaining the secretory power—i.e. the state of the kidneys—and therefore can form some idea of the ability of a patient to successfully sustain a severe operation. This point is, of course, of especial importance when such an operation is performed on the urinary tract. See URETHRAL FEVER.

VICTOR HORSLEY.

URETHRA, Diseases of the.—These include urethritis, with its consequences—warts, gleet, peri-urethral abscess, inflamed follicles, stricture, neuralgia, syphilitic, chancreous, and tubercular ulcers. Many of these affections have been described under the articles CHANCER; GLEET; GONORRHOEA; STRICTURE OF THE URETHRA; SYPHILIS; URETHRAL FEVER.

URETHRITIS, following coitus with women suffering from leucorrhœa or other non-gonorrhœal muco-purulent discharge, is a milder affection than gonorrhœa, though probably often closely resembling that disease. But urethritis is not exclusively due to contagion. It may be caused by injury, by gout, or by tubercular disease. Nevertheless, all these forms are, in comparison with gonorrhœal urethritis, rare affections. Excessive beer-drinking in young men, and, in children, the irritation of worms in the intestines, are stated to sometimes cause slight urethritis. Again, certain vegetables—e.g. asparagus—and turpentine and cantharides are accused of exciting a mild urethritis, besides specially irritating the kidneys.

Occasionally also, a very mild urethritis accompanies the early macular eruption of syphilis; it is always very limited, and subsides spontaneously.

In *traumatic urethritis*, the signs of irritation follow the passage of the calculus or other foreign body without delay. Soreness is felt at the first micturition after the injury has been inflicted; swelling and discharge are evident, at latest, twenty-four hours after the occurrence. Like other forms of urethritis, the traumatic variety may be followed by inflammation of the prostate, testicles, bladder, or kidney. Orchitis is, probably, the most frequent form of this secondary inflammation.

In *gouty urethritis*, the inflammation usually begins, and irritation is generally first felt at the membranous and prostatic portions, not near the meatus as in gonorrhœa, and causes greatly increased frequency of micturition. This irritability of the bladder, coming on at once and out of proportion to the amount of inflammation of the rest of the passage, is very characteristic of the gouty form. Patients who suffer from it have had also symptoms of gout elsewhere, or pass uric acid crystals. They are usually of full habit, over forty years of age, and addicted to the pleasures of the table. Too much reliance must not be placed on the gouty symptoms, inasmuch as gonorrhœa is not uncommon in men of the habits just mentioned. Gouty urethritis affects both sexes, though much more common in men. The inflammation may be as severe as it is in well-marked cases of gonorrhœa, pus being secreted freely; or it may give rise to the complications of the bladder, testis, joints, and eye which attend or follow gonorrhœal urethritis. The leading distinctions of gouty urethritis are—the history or presence of gout elsewhere, the usually scanty discharge, notwithstanding the great amount of scalding in the perineum and irritation of the bladder felt by the patient. Further, the symptoms are generally dispelled by remedies appropriate to gout. The termination of gouty urethritis is nearly always by resolution. If it is followed by prostatitis or epididymitis, abscess may form, and septic infection may possibly succeed, with its various consequences.

A very obstinate form of urethritis, probably allied to gout, is occasionally met with—the *eczematous*. In the cases which the writer has seen at the Lock Hospital and elsewhere, the patients have been between forty and fifty, of full habit, beer-drinkers, and suffering from eczema on the skin. In

these cases the surface of the glans around the meatus was bright red and very tender. The interior of the urethra for two or three inches, in one case as far as the membranous portion, was also bright red, but did not bleed readily when the endoscope or the bougie was passed along. There was a scanty, milk-white discharge, and the patient complained of constant burning pain along the urethra. Passage of urine or of instruments increased the pain greatly for the time. No further change appeared to take place in this obstinate affection; relief was given by cold water injections, or by the cold irrigation-coil round the penis, and benefit was derived from arsenic, alkalies, and careful diet.

Tubercular urethritis is at first an indolent affection, due to the slow ulceration of the tubercular products in the mucous membrane. The affection, though it may occur at any part of the urethra, is much more widely developed in the mucous membrane of the neck of the bladder. The discharge is scanty, often somewhat bloody. Soreness in the urethra during micturition is very slight, being generally little heeded in comparison with the severe burning pain and spasm of the neck of the bladder which accompany or follow every act of micturition. Should a sound be passed, intense pain is felt as the instrument reaches the ulcerated surfaces, which lie most commonly about the prostate, and before the bladder is entered. The extreme, unassuageable irritability of the bladder is characteristic, becoming in the end constant torment. The mucus secreted by the cystitis that spreads generally over the surface of the bladder sets up decomposition and produces ammoniacal, putrid urine, which irritates still more the ulcerated surfaces and excites the frequent spasm. Tubercular disease in time spreads to the body of the prostate, the vesiculæ seminales, and the epididymes, and thus gives corroborative evidence of the nature of the urethritis.

The terminations of tubercular disease may be cicatrization of the ulcers, when the contraction of the cicatrix may produce stricture in rare cases; but, usually, death is caused by the tubercular disease spreading to the bladder and kidneys, causing death by their destruction, or by developing acute tuberculosis of the lungs or other viscera.

The *treatment* of traumatic urethritis consists in the first onset of allaying irritation by salines, diluent drinks, low diet, and aperients. When severe, the patient must

rest in bed; should spasm and irritability of the bladder come on, 5 to 10 minims of tincture of belladonna should be given in camphor water every four or six hours, with careful watching of the effect of the drug on the patient. Warm poultices and fomentations of the perineum are beneficial; and, if abscess form there, its contents must be immediately let out. Should urinary fever with partial suppression of urine set in, the treatment proper to that affection must be adopted. Usually, the slighter forms of traumatic urethritis subside in a few days, if the exciting cause be removed or not applied a second time; but it may be a serious and dangerous affection.

In treating the gouty urethritis, more benefit can be obtained by attacking the general condition than by treating the local affection. Free purging, with mercurial and other cholagogues, and citrate or bicarbonate of potash with colchicum, in frequent moderate doses, are needful. These measures, with low diet and continued abstinence from food likely to excite gout, aided by hot baths and other sudorifics, usually arrest the irritation quickly. Care in avoiding all but very moderate exercise, and the support of the testicles in a suspensory bandage are requisite to prevent the urethritis from causing prostatitis or epididymitis. The gleet left by the urethritis is obstinate, being mainly secreted in the prostatic portion of the canal and from its ducts. Local treatment and counter-irritation usually aggravate the discharge; better results are gained by persevering with the treatment for gout, and, when that condition is quiet, by administering ℞v. to x. of copaiba or 15 to 20 grains of cubebs, or some similar remedy, three times a day. Obstinate cases are often thoroughly cured by a course of saline waters, such as those of Homburg or Plombières, Bath, Carlsbad, or Toplitz.

In tubercular urethritis, the treatment is mainly that useful to combat the tubercular disease—rest, warmth, dry sunny climates, nourishing food, cod-liver oil, and iron. The spasm and pain often require large doses of belladonna and morphia in suppositories and by the mouth. If cystitis supervene, washing out with a solution of boric acid of half the saturated strength gives relief for a time; but drainage through a perineal opening is necessary to prevent the accumulation of urine in the bladder, when the cystitis is marked and the patient worn by pain and spasm.

NEURALGIA OF THE URETHRA.—This term is given to a painful affection of the urethra,

occurring when no disease can be detected in that part of the urinary apparatus.

The *causes* of the affection are very numerous, and may be divided into two groups: those referred to general disturbance of the nervous system and those connected with reflex irritation set up by local disorder of neighbouring parts. It is most frequent in the male sex and during the middle period of life; but it is not unknown in women and children. It may follow excessive coitus, masturbation, and repeated sexual emotion, or accompany neuralgia of other parts of the body. A superabundance of phosphates or of uric acid in the urine is also a frequent cause. Of causes of a reflex kind are—disease of the kidney, constipation, flatulent dyspepsia, fissure of the anus, piles, uterine disease; of causes more closely connected with the urethra are congenital narrowness of the meatus urinarius, enlarged prostate, stone or atony of the bladder. Lastly, in some cases none of these causes can be detected to explain the painful condition of the urethra.

The *symptoms* of this affection are—increased frequency of micturition, smarting pain, and difficulty in voiding urine; sometimes also a sense of heat and itching at the tip of the penis; aching pain beginning in the penis and radiating to the pubes, groins, loins, buttocks, and thighs. This is a not infrequent form, often recurring and ultimately almost continuous. In some persons the physical pain is accompanied by mental despondency, irritable temper, or dread of society.

The course of the affection is very capricious, irregular, and intermittent. It often assumes a certain periodicity, or comes and goes without obvious cause. The disorder thus affords long intervals of freedom from pain, to return when the general condition has been disturbed by some of the diathetic causes already mentioned. Sometimes, the passage of a small quantity of highly acid urine will bring on an attack of neuralgia, which copious draughts of simple diuretics, water, barley-water, or weak gin and water will speedily allay.

The *diagnosis* is formed chiefly from the obstinacy and severity of the pain with complete remissions, the absence of congestion of the mucous membrane and of discharge, and the existence of some of the causes of neuralgia already mentioned. Not infrequently the diagnosis is reached by the simple process of exclusion.

The *treatment* resolves itself into removal of any local disease which excites the neuralgia, if that be curable; and the

palliation by anodynes, regimen and diet, of those, such as renal or prostatic disease, which are incurable. The phosphatic diathesis is remedied by tonics, mineral acids, fresh air and exercise, and sufficient amount of animal food. There should be also prohibition of coffee or strong tea, as those beverages are prone to cause precipitation of the phosphates and consequent painful micturition. To these measures, in obstinate cases, may be added a change of climate from a cold damp one to a warm sunny one. A course of saline aperient waters at Kreuznach, Harrogate, Carlsbad, and other baths is useful; or, if this be not procurable, free purging by saline aperients, when excess of uric acid depends or accompanies defective action of the liver, is often effective in procuring a cure.

For local treatment, the most efficacious remedy is the repeated passage of bougies and sounds. Usually, this operation is much dreaded by the patient, and causes him at first considerable pain of a hot, burning character. But if great gentleness be exercised and small pliant bougies be employed until the urethra has lost its hyperæsthetic condition, the suffering is only momentary, while the diminution of the constant irritation encourages the patient to submit to a repetition of the operation. When the passage has grown accustomed to bougies, full-sized steel sounds, well heated and oiled, may be passed twice or thrice a week until the neuralgia is considerably abated. Recourse may then be had to cold injections, cold hip-baths and other local stimulants of the circulation through the genitals. Repeated blisters to the perineum, produced by painting an area of half an inch square along the raphé with blistering fluid, are valuable when there is any tendency to prostatic congestion; but, to do good, blisters must be persevered with for several weeks.

WARTS, as little pedunculated or sessile projections, identical with those seen in the furrow behind the glans or on the glans and inner surface of the prepuce, are a not uncommon affection of the mucous membrane. They are situated usually in the first inch beyond the meatus, though sometimes they can be seen by the endoscope growing at a greater depth from the surface. It is probable that true warts are not found more than three inches from the meatus. Again, they occur in persons who have a proclivity to them—that is, have warts on the glans or prepuce as well, or who have had them in boyhood on the hands or elsewhere. Urethral warts are always consequences of

gonorrhoea, and do not arise without the stimulus of acute irritation. In structure they are simple papillomata, and vary in size from that of a pin's point to that of a small pea. So long as they remain in the urethra, they give rise to itching and tickling there and secrete discharge. They are easily removed by touching them with an astringent solution or by snipping them off, when they are within reach. Those which are seen only with the endoscope, are destroyed by touching them with a solution of nitrate of silver of twenty grains to the ounce of water.

PERI-URETHRAL ABSCESSES are also nearly always a consequence of gonorrhoea, and may begin at any part of the canal. Most frequently they develop just within the meatus, between the under surface of the urethra and the frænum preputii further on, or at a point about three inches from the meatus. They begin either by inflammation of a closed follicle, or as abscesses having no communication with the urethra, and spread both towards the skin and towards the mucous membrane. They may open on both surfaces, but most commonly do so externally. When forming beneath the frænum, they are often of slow growth and form a prominent swelling on either side of it. When they have broken, the pus escapes, but the cavity is slow to heal, and the pus collects again and again, to be discharged from time to time through a minute aperture. Should the abscess force its way to the urethra, it usually also opens on to the skin and thus produces a urethral fistula. If the abscess have formed in the part behind the bulb, the depth of the situation causes the abscess to be long in reaching the surface, and it may percolate between the layers of the superficial fascia to the scrotum or at the side of the crus penis for a considerable distance, before it makes its escape.

If the deeper abscesses break into the urethra, a troublesome purulent discharge remains, and the cavity of the abscess fills from time to time and may obstruct the flow of urine along the urethra.

The *treatment* consists in early puncture, and the maintenance of a free outlet for the pus until the cavity is closed by granulation. If there be a fistula, this usually closes in a short time, provided there be no obstruction, by stricture or otherwise, to the passage of urine by the urethra. Hence, the urethra must be searched for contractions, and any that are present be widened by treatment. The little obstinate pouches of matter, which lie on either side of the frænum in the furrow, are best treated

by a free incision, and plugging the interior of the cavity with iodoform lint to ensure drainage and granulation.

BERKELEY HILL.

URETHRA, Foreign Bodies in the.—Foreign bodies found in the urethra have either entered that canal directly from the external urinary meatus, or have passed into it after a long or short residence in the bladder. Calculi of purely renal or vesical origin arrested in the urethra are not referred to here, but are fully discussed under **STONE IN THE URETHRA**. Foreign matters obtain entrance into the bladder and thence into the urethra, either through injuries which cause penetrating wounds or in consequence of disease. As the result of direct injury, shot, pieces of clothing, or fragments of bone are met with, while portions of bone, the contents of dermoid cysts, fruit-stones, and other fecal matters from the intestines, are consequences of disease. *See FOREIGN BODIES IN THE BLADDER*.

Most usually, the urethral foreign body has been introduced directly from without, through the external meatus, and is a portion of bougie or catheter which has become detached while the instrument has been lying in the canal; but straws, pieces of pencil, quills, penholders, pebbles, fruit-stones, pins and needles, are not infrequently passed into the urethra, and allowed to pass beyond reach of recovery. Such bodies are introduced by patients themselves for the treatment of real or supposed disease, or as a means of inducing improper excitement of the sexual organs. Sometimes they are passed in by others from curiosity or mischievously, when the sufferer is asleep or drunken.

The discomfort occasioned in the urethra varies with the nature of the foreign body. It may cause retention of urine with all its troubles and dangers, or inflammation of the urethra, with considerable constitutional disturbance, may result. Sometimes little immediate discomfort is experienced, the foreign body becomes impacted and gradually is encrusted with urinary salts. The diagnosis is made by first examining the urethra externally through the penis and perineum, and with the finger in the rectum. Afterwards, a small sound may be introduced into the urethra, and the nature and position of the foreign body more accurately ascertained. Care must be taken, in making this examination, not to push the body further down the urethra or into the bladder. Much ingenuity has been expended upon the invention of urethral

forceps for the extraction of foreign bodies, and there are numerous varieties, but the best is, perhaps, that one known as the simple, long urethral forceps. The long urethral scoop or curette is a useful instrument, and a loop of silver wire may be made to do good service.

Treatment.—If the foreign body is engaged in the penile portion of the urethra, its further progress towards the bladder should at once be arrested by tying a piece of elastic drainage-tube, or an india-rubber catheter firmly round the base of the penis. Here it may be remarked, that all foreign bodies which are elongated and therefore possess distinct ends, when once engaged in the urethra, will naturally pass inwards or outwards according as the end which offers least resistance is directed outwards or inwards. Thus the end of a broken catheter will tend to pass rapidly into the bladder, owing to the action of the muscular fibres of the urethra, because the rounded non-resisting end is towards the bladder and the rough resisting end is directed outwards. Round, smooth, urinary calculi, drops of urine, semen, and pus, are all expelled outwardly. If the patient has plenty of urine in his bladder at the moment of the introduction of the foreign body, the urethra may be injected with olive oil, the meatus pinched between the finger and thumb, and the patient directed to make a full stream of urine forcibly, when, upon the meatus being released, the foreign body may fortunately be expelled. If, however, it is not expelled, the surgeon may attempt to manipulate the body through the walls of the urethra, and so squeeze it out.

If this plan is not successful, the urethral forceps or scoop must be carefully tried. Their use is usually very distressing to the patient, and sometimes an anæsthetic has to be employed. The patient must lie on his back, and the surgeon should steady the foreign body and prevent its being passed further down the urethra by pressing behind the body upon the urethra, either in the penis or perineum, or with his finger in the rectum. The forceps may then be passed down to the foreign body, and a careful attempt made to extract it. Sometimes the surgeon will succeed with the urethral scoop or curette, when he has failed with the forceps. If the foreign body be a piece of gum elastic bougie or catheter, and a small gum catheter can be passed by its side into the bladder, it will often be well to tie this catheter in for a few days, in the hope that on its withdrawal the vagrant piece of catheter will come away

also, having become glued to the inlying catheter. This method should only be tried when an attempt with the forceps has failed. The knife can rarely be required to cut down upon a foreign body in the urethra. Such a proceeding is, however, occasionally justifiable, and it is most proper to do so if the body is engaged behind an organic stricture of the urethra. In such a case, after the body has been removed, the stricture should be thoroughly divided internally or dilated, otherwise a fistula will almost certainly result. In cutting down upon a foreign body, care should always be taken to draw the skin of the penis well forwards; after the operation the incisions into the skin and into the urethra will not correspond, and the parts will rapidly heal.

Occasionally, foreign bodies of a peculiar character will be met with in the urethra, which will tax the manipulative skill of the surgeon. Hairpins and shawlpins have sometimes called for exceptional ingenuity. A hairpin is usually introduced with the bent portion towards the bladder. Directly the pin has passed from the patient's grasp, the legs of the pin spring apart and the ends become firmly fixed into the urethra. In such a case a metal tube (a piece of silver catheter) may be passed down to the pin, the legs of which are firmly pinched together through the urethral walls, and slipped into the metal tube, which is then withdrawn, bringing away with it the pin safely. Another plan of dealing with such a case is to hold the penis forcibly against the abdomen, and with the finger in the rectum the ends of the pin may be made to protrude through the walls of the urethra and skin of the penis. One leg of the pin may then be cut off close to the skin and the the rest of the pin twisted out. A shawl- or large-headed pin may be treated in much the same way, supposing the head of the pin to have been passed in first, towards the bladder. The point may be pressed out through the urethra and skin, and then brought well down towards the patient's anus; the head of the pin can then be pushed up to the external meatus and the whole pin removed.

In the performance of lithotripsy, the jaws of a lithotrite loaded with débris may become fixed in the urethra. If this is due to stricture, a small tenotome may be introduced under the skin, the stricture divided subcutaneously, and the lithotrite withdrawn, or the blades of the lithotrite may be cut down upon, then protruded, cleared of all débris, approximated, and withdrawn by the natural passage. G. BUCKSTON BROWNE.

URETHRA, Injuries of the.—These are caused by falls, kicks, blows on the perineum or penis, by gunshot wounds, cuts, by twisting the penis during erection, or blows given to relieve chordee, by the tying of strings tightly round the penis, and by the impaction of calculi or the passage of foreign bodies (such as catheters) along the canal. The consequences are bruises, lacerations, incisions, sloughing and loss of substance; afterwards, as results of this loss of substance, firm fibrous stricture or complete obliteration of the urethra for a short distance.

Of perineal injuries, a frequent cause is falling when walking along the joists of an unplanked floor. The legs slip between the joists, and the perineum is violently struck against one of them. By this accident the bulbous or membranous portion of the urethra may be simply bruised, lacerated along its floor, or so completely divided that its continuity is lost.

When the perineum is struck the amount of hæmorrhage is often considerable. As the skin is seldom divided, the blood, escaping into the cellular tissue, causes swelling of the perineum and scrotum; the skin of which quickly turns purple or black. There is much pain and general shock, and there may be inability to void urine from the compression of the extravasated blood on the urethra. If the urethra be torn as well as bruised, blood, usually in small quantity, escapes from the meatus urinarius. Occasionally, the flow of blood from the urethra is dangerously copious. After this accident, if the neck of the bladder as well as the urethra be injured—a complication that is more common when the injury to the urethra is secondary to fracture of the pubic bones—the urine escapes from the bladder at once, not waiting until the patient attempts to micturate before it invades the cellular tissue of the perineum, scrotum, and integuments of the abdominal wall. When the urethra alone has been lacerated, the bladder retains its contents until the patient passes urine; then several consequences may follow. The urethra may be blocked by coagula, and the urine consequently be driven through the tear in the urethra, and extravasation take place. Or urine is voided through the meatus in great part, a small quantity only escaping into the cellular tissue, at once exciting irritation there. The contact of urine with the wounded surfaces materially increases the patient's sufferings. A stinging pain is felt, and great anxiety and prostration ensue, which continue until

an outlet is made by sloughing and abscess, when the urine escapes through the gaps caused in this manner. Finally, the urine continues to escape through these artificial channels, which contract to fistulæ, the perineum is thickened by numerous tough scars, and the urethra is tightly contracted by fibrous stricture. Not infrequently the patient is exhausted by pain and irritation, and dies before the process of repair and cicatrisation begins. The diagnostic sign of bruise of the urethra is the immediate escape of blood by the meatus urinarius; that of laceration of its walls, a pricking, stinging pain, felt when the patient proceeds to pass urine. This act is often involuntarily performed immediately after the accident, through the fright and shock caused by the injury.

The *treatment* of cases of injury to the perineum by falls or blows is regulated by the amount of injury the urethra has received. If it is only bruised, but no aperture is made in its wall, the patient must be kept in bed, opiates and restoratives being given as needful. Cold evaporating lotions, ice-bladders, and leeches should be applied to the perineum if the rupture of the vascular structures of this region (erectile tissue, transverse perineal arteries, artery to the bulb), cause rapid swelling from extravasated blood. If these methods fail to check the swelling, a catheter must be passed to the bladder and tied in, while firm pressure is made against the perineum with a padded crutch fixed by bracing it firmly to the thighs above the knees. The catheter should be a silver one, No. 10 or 12 of the English scale, because the point of such an instrument can be most readily guided along the roof of the urethra, the part least likely to be injured. If, though the hæmorrhage be not excessive, retention from coagula blocking the urethra comes on, a catheter should be tied in and retained for a week, to give time for the wound in the urethra to heal sufficiently to prevent urine escaping into the cellular tissue, after the catheter is withdrawn.

When besides the free escape of blood *per urethram*, there is complaint of pricking pain, with more or less difficulty in voiding urine, while the swelling increases steadily, an attempt should be made at once to pass a silver catheter to the bladder. If it reach the bladder, the further steps for opening the perineum are followed with greater confidence. But, if the bladder be not reached, the instrument should be passed as far as it will go along the urethra, and an incision be made

at the point where its beak is arrested. The incision must always be carried scrupulously along the middle line to give free escape to the urine, to avoid wounding important blood-vessels, and to increase the probability of reaching the urethra behind the injury. If this is found, and a guide can be carried along it to the bladder, a tube must be passed to it and tied in. When the bleeding is small, a flexible tube of india-rubber or of 'gum-elastic' may be carried through the wound to the neck of the bladder, to bring away the urine as fast as it reaches the bladder from the kidneys. If there be free hæmorrhage after the perineal incision is made, which is a very uncommon event, the flexible tube may be replaced by one of hard rubber or a stiff lithotomy tube with a petticoat or Brown's tampon, and the wound plugged round the tube for a few hours till the bleeding stops. Every wandering collection of urine in the cellular tissue of the scrotum, groins, or abdominal wall should be opened by incisions, and allowed to drain into warm boric acid dressings.

If, after the perineum has been opened in the middle line, the urethra be not readily found, it is best to desist from further search for the canal until the lapse of a week has allowed the swelling to subside. The gap in the urethra by which the urine escapes will be then found with ease, and the remainder of the passage to the bladder traced. This direction for delay implies, of course, that there is no retention, that the urine escapes through the laceration in the urethra, and by the incision in the perineum to the surface. When retention is present, the distended hinder portion and neck of the bladder are not usually difficult to discover. If, nevertheless, the opening cannot be made out, the bladder must be punctured *per rectum* and a catheter tied in through the puncture.

Great cleanliness is necessary, and support by nutritious food and opium must be given freely.

The urethra is sometimes lacerated in attempts to relieve chordee by resting the erect organ against the edge of a table and striking it a sharp blow. The distended corpus spongiosum is ruptured, and occasionally the urethra also, when free hæmorrhage *per urethram* takes place. The consequences are often abscess in the corpus spongiosum, and fibrous stricture of the urethra at the site of the injury.

Another mode of damaging the urethra is to tie a string tightly round the penis or to slip a ring over the glans, thereby

causing swelling and sloughing of the constricted part and fistula.

Among foreign bodies which injure the urethra the most common are metallic catheters or sounds, used by surgeons or by the patients themselves in attempts to treat stricture; the lacerations are called 'false passages.' They are usually single; but occasionally there may be two or three such false routes. The urethra is perforated most commonly in the floor or at the left side of the passage; and the perforation is made in front of the stricture or at the bulbous portion, before the triangular ligament is reached. The false passage passes backwards between the urethra and rectum. Sometimes it enters the urethra again behind the stricture; though more frequently it penetrates into the rectum. If left alone, these passages will sometimes close; but more often they remain permanently open, and render the patient liable to abscess or urinary fever, if a catheter be pushed into them on any occasion.

Calculi while drifting from the bladder to the meatus may become lodged in the irregularly shaped prostatic portion, or in the narrowest portion of the urethra, the last three inches. There they may cause ulceration and abscess, and even work their way out of the body by this means. In the prostate they nearly always remain as permanent causes of pain, irritation, and suppuration. In the penile urethra, the immediate effect of their impaction is usually retention of urine; and in attempts to relieve this obstruction or to withdraw the calculus, the urethra is often seriously injured. If the calculus is tightly fixed in the penile portion, it may be successfully removed through a longitudinal incision made over it, which incision should be at once sewn up, and the urine drawn by catheter from the bladder while the wound unites. If the stone be not fixed it may be pushed back to the bladder, where it may be crushed or extracted by lithotomy. *See* STONE IN THE URETHRA.

A great variety of articles have been pushed or let slip into the urethra, such as hairpins, pen-holders, catheters, &c. Sharp-pointed articles like hairpins can be extracted by bending the urethra over the point of the pin until it projects through the skin. It can then be seized and withdrawn. If the foreign body to be extracted lie in the membranous portion of the urethra, a finger should be kept in the rectum during these manipulations, to prevent the body from slipping into the bladder. *See* URETHRA, Foreign Bodies in the. *BERKELEY HILL.*

URETHRA, FEMALE, Affections of the.—The female urethra, measuring about one and a half inches in length, extends downwards and forwards from the neck of the bladder to terminate externally in the opening known as the *meatus urinarius*, situated in the middle line immediately in front of the vaginal orifice. The canal, which lies more or less completely embedded in the anterior vaginal wall, is narrowest at its external orifice, and admits throughout of great distension—a fact of considerable importance in relation to the diagnosis and treatment of certain affections of the bladder.

Artificial dilatation of the urethra for diagnostic purposes may be readily effected by the use of graduated bougies or specula, or even by means of the finger alone in certain instances. Experience has shown that *rapid* dilatation, carefully performed, is on the whole preferable to the more gradual methods of procedure, as being less likely to be followed by incontinence of urine.

I. MALFORMATIONS.—1. *Congenital* defects due to imperfect development are of very rare occurrence, and are commonly co-existent with some malformation of the adjoining parts. The following may be mentioned as well-recognised conditions: (1) total absence of the urethra; (2) defect of its external portion (hypospadias); (3) defect of its internal portion; (4) atresia of the canal.

2. *Acquired* conditions, affecting the calibre of the canal or its direction, may arise from various causes.

Dilatation of the urethra in whole or in part, due to a relaxed state of its walls, may result from displacements of the canal, accompanied by inflammatory thickening of its lining mucous membrane (conditions usually traceable to child-bearing); or may be consequent upon mechanical causes, as stricture, or the presence of neoplasms, calculi, &c. The *symptoms* vary according to the extent and the exact seat of the dilatation, while further depending upon the state of the mucous membrane, which, when inflamed or prolapsed, will give rise to frequent and painful micturition.

Dilatation of the *lower third* of the canal often causes no functional derangement whatever, unless ulceration or inflammation exist.

When there is dilatation of the *upper third* of the urethra, the patient is usually subject to partial incontinence of a most distressing character.

In dilatation of the *middle third* (*sacculation, urethrocele*), there is recognisable a pouched swelling in the anterior vaginal wall, into which a catheter can be passed. Micturition is frequent, and accompanied by straining efforts consequent upon reflex tenesmus excited by the retention of decomposing urine in the pouch, of which the involuntary escape on exertion usually renders the patient's condition one of extreme discomfort.

Treatment.—An inflamed or relaxed state of the mucous membrane *in the neighbourhood of the meatus* may be remedied by the use of astringents, such as tannic acid or alum. Should these fail, redundancy of the prolapsed mucous membrane may be dealt with by applying the fine point of the thermo-cautery to a narrow strip on each side, parallel to the axis of the canal, so as to avoid stricture of the meatus from subsequent contraction of the cauterised tissue. Or, if necessary, a narrow V-shaped portion of mucous membrane may be excised, and the edges adapted by fine sutures.

Dilatation of the *upper third* of the canal must be treated simply by the use of a suitable anteversion pessary.

The surgical treatment of *urethrocele* consists in excising an elliptical portion of the anterior vaginal wall, so as to completely open the cavity of the pouch, the lining membrane of which is to be carefully dissected off as far as the aperture communicating with the urethral canal. The freshened surfaces are then thoroughly coapted by deep sutures of fine silver wire, so passed as to include the margins of the opening in the floor of the urethra. These should be left undisturbed for eight or nine days, a catheter being meanwhile retained in the bladder for the first four or five days after operation.

Stricture.—A much less common affection in women than in men. It may occasionally be met with as the result of inflammation or ulceration due to specific disease, or consequent upon the use of caustics. Cicatrices in the vaginal wall, resulting from injuries during childbirth, may also give rise to contractions of the canal, which, again, may become permanently narrowed from disuse in cases of long-standing vesico-vaginal fistula.

The chief *symptoms* caused by stricture are frequency and difficulty of micturition.

Treatment.—Stricture of the *meatus*, the most common form of contraction, may be either divided or forcibly dilated,

methods of treatment equally applicable to strictures of inflammatory origin seated higher up in the canal. In cases of contraction of the entire urethra, gradual dilatation by bougies should be practised.

Displacement of the urethra in an upward direction may be caused by the presence of a pelvic tumour pushing the bladder up out of the pelvis. *Downward* displacement, to a greater or less extent, invariably accompanies prolapse of the bladder (cystocele). Incontinence of urine or difficulty of micturition, according to the degree of displacement, results from this condition.

Treatment must aim at the rectification of the prolapse.

II. FOREIGN BODIES in the urethra may either come from *within*, as calculi or substances which have entered the bladder by perforation of its wall (foetal remains, hydatids, faecal concretions, gall-stones, &c.), or may have been introduced or have penetrated from *without*. In any case the chief *symptoms* are retention with pain and tenesmus. Injury to the wall of the urethra may cause hæmorrhage, and be followed by peri-urethral inflammation.

Treatment.—Extraction of the foreign body is to be effected with the help of fine forceps or with a wire loop, guided by a finger in the vagina. Care must be taken to avoid laceration of the parts.

III. URETHRITIS. — *Inflammation of the Lining Membrane of the Urethra*.—The acute form is commonly, although not necessarily always, of specific origin. In such cases its onset is usually sudden, being preceded or accompanied by inflammation of the vagina and vulva. The prominent *symptom* is urgent and painful micturition (scalding), occasionally followed by hæmorrhage from the meatus. The urethral discharge may be revealed by pressure along the course of the canal in the vagina.

Treatment consists of the use of local baths, with the employment of sedative vaginal suppositories. Free purgation, followed by the administration of salines with hyoscyamus, usually answers well. In *subacute* cases the cautious injection of a solution of nitrate of silver or sulphate of zinc may be tried. In *chronic* cases the passage twice a week of a full-sized bougie has been recommended.

The existence of a *fissure* in the immediate neighbourhood of the neck of the bladder resulting from a urethritis may be the cause of great discomfort, tenesmus, and pain both during and after micturition.

The endoscope is essential for its discovery and treatment, which can be effected either by the application of nitrate of silver fused on a fine probe, or by incision as practised in fissure of the anus.

IV. FISTULA.—For *complete* or *urethro-vaginal* fistula, see VAGINAL FISTULÆ. *Incomplete internal* urethral fistula may be met with as a blind sinus extending downwards from the floor of the canal, as the consequence of a peri-urethral abscess. Its existence can be detected by the passage of a probe *per urethram*, while the finger presses upon the anterior vaginal wall.

The *symptoms* to which it gives rise are pain and frequency of micturition, with vesical tenesmus; there is usually a constant sense of heat and discomfort about the part, and occasional traces of pus occur in the urine.

Treatment.—The sinus should be converted into a *complete* urethro-vaginal fistula, which may be subsequently closed by operation if it be found necessary to interfere surgically.

V. NEW GROWTHS.—Of these the most common form is that known as *vascular growth of the meatus* or *urethral caruncle*. See VULVA, Affections of the.

Varices of the urethral veins, analogous to rectal hæmorrhoids, most commonly affect the floor of the canal, and may occasionally cause obstruction to the flow of urine. The occurrence of submucous rupture of an over-distended vessel will lead to the formation of a urethral *hæmatoma*. *Treatment* should be directed to the relief of the impeded circulation.

Cysts of glandular origin are not common, but may be met with at any age. If polypoid in shape, they may cause obstruction.

Fibrous growths are of rare occurrence. They are met with embedded in the urethral wall; or as projecting polypi, usually seated in the neighbourhood of the meatus.

Sarcoma urethræ has been described, but the affection is an extremely rare one.

Epithelioma of the female urethra, whether of primary origin or secondary by extension, is also of very uncommon occurrence.

The *symptoms* caused by urethral neoplasms are pain and difficulty in micturition, sometimes amounting to complete retention, partly due to spasm. Dyspareunia and a train of nervous symptoms are occasionally traceable to their presence. The more vascular growths may give rise to hæmorrhage.

A growth presenting at the meatus will be readily detected; when seated further up in the canal, its presence may be recognised by pressure of the finger along the course of the urethra in the vagina. Dilatation of the meatus and the introduction of the urethral speculum will facilitate the investigation of its nature.

Treatment.—Extirpation of *non-malignant* growths is to be effected by caustics, or by means of the ligature, by torsion, or by excision. The curette, the *écraseur*, or the galvano-cautery may be advantageously employed, care being taken in any case to effectually remove the whole of the new growth.

W. A. MEREDITH.

URETHRAL FEVER, or the pyrexia frequently following mechanical treatment applied to the lower urinary tract, is a condition which, in all probability, is due to direct disturbance of the central nervous system—i.e. the spinal cord and the medulla oblongata—and which presents all the symptoms of an acute specific fever.

Etiology and Causation.—Urethral fever, as its name signifies, is dependent for its origin on certain conditions of the urethra. If the mucous membrane of that passage is irritated by some means or other, there follows a rise of temperature, rapid or gradual according to circumstances detailed below, the pyrexial rise being accompanied by a shivering fit or cold stage not long before the temperature reaches its maximum. As may readily be observed, the symptom of shivering or shuddering is sometimes seen in healthy persons in whom the urethra is perfectly normal, but irritated by the mere flow of urine, as in the simple act of micturition. But, further than this, the symptom of pyrexia may also be observed, in a very mild degree, as a result of stimulating the normal urethra. An artificial fever is thus sometimes seen, clinically, to follow the passage of a catheter for some trifling inability to pass water, owing to reflex spasm, &c.

What occurs thus in health, is repeated on a wider scale and with far greater intensity in disease. Since, however, every degree of constitutional disturbance can be found between the slight shivering, &c., observable in healthy people and the most severe or fulminating variety of the pathological pyrexia, we have good ground for believing that the two things possess a common cause; and this is to be found in the fact of there being, in each instance, a disturbance of the central nervous system by irritation of the periphery. We can

scarcely do more here than refer to the articles on **RIGOR**, **SURGICAL FEVER**, and **NEUROTIC FEVER**, for an explanation of the manner in which nerve-irritation may be supposed to evoke such symptoms, and will pass on to examine the scanty etiological facts which help to explain several differences in the clinical histories of cases of this affection.

It was shown by Fergusson that urethral fever occurred most severely in those patients who had not been previously catheterised, and that where instruments had been freely used, constitutional disturbance was very exceptional. This partly expressed the facts of the case, since about forty per cent. of the cases, in which the severest form of urethral fever occurs, are those which have undergone no previous treatment whatever. The principal factor, however, in the causation of urethral fever appears to be the age of the stricture. Thus, the average age of the stricture in cases of fulminating urethral fever is less than eighteen months, whereas in the milder forms it is as much as eight years, and in 'apyretic' cases much older still. The simplest explanation of these facts is that we have, in urethral fever, to do with a fever which is essentially neurotic in origin. See **NEUROTIC FEVER**. In a recent stricture, the nerve-fibrils and nerve-endings (already hypersensitive from the specific inflammation of the surrounding tissues) are capable of transmitting a severe shock to the spinal cord, &c.; while in an old stricture, we may very justly assume this peripheral nerve-supply to be considerably damaged by the shrinking of the stricture-cicatrix, so as to make it more or less insensitive to mechanical irritation.

A very important element in the causation of urethral fever is the mode of instrumentation which evokes the pyrexia. To put this question most briefly, we may say that laceration is more productive of fever than is incision. Thus, it occurs more frequently in cases which have been subjected to catheterism and rupture of the stricture, than in those where division has been effected with a urethrotome. A predisposing cause of great influence is that of malarial fever, as pointed out by Fayrer. If a patient with stricture have previously suffered from some form or other of malarial fever, he is practically certain to be the victim of urethral fever if his stricture is treated mechanically, unless certain prophylactic measures are taken. See *Treatment* below. Other predisposing factors are to be found in other causes of depression

affecting the nerve-centres—e.g. exposure to cold, alcoholism, &c.

Pathology.—Whether or not the process of urethral fever is primarily a neurosis set up by peripheral irritation, cannot yet be decided (*see* SURGICAL FEVER); but this much at least may be said, that, whether true or not, this is a very good working theory, and treatment based upon it is safe and efficacious. The foregoing applies simply to those cases where a pyrexia, of varying degree, directly follows (as will be described presently) interference with the urethra, and where no complication from affection of other organs—e.g. kidneys, &c.—exists. But the operation of dilating a stricture is sometimes capable of producing intense congestion of the kidney, and frequently partial or complete suppression of urine. This effect on the secretory power of the kidneys finds a parallel in the rigor and pyrexia, being due to reflex disturbance of the spinal cord, &c.; and since this very awkward and frequently fatal complication possesses a like pathology to the pyrexia, &c., it may be partly averted in a similar way. As the result of a preliminary investigation, it may be stated that the actual change in the kidney-excretion in an ordinary case of urethral fever is very small, as regards the amount of water and of nitrogen. For the pathology of cases of suppression of urine the reader is referred to the article on that subject.

Post-mortem Appearances.—Urethral fever is very rarely fatal, and when it is so the result is owing to causes not yet explained, but connected with the sudden arrest of the renal secretion. Usually, after death the kidneys are found congested and the seat of old cirrhotic disease (interstitial), but nothing organic has yet been detected in the central nervous system.

Symptomatology.—Urethral fever presents itself clinically in two well-marked groups: one which may well be called fulminating, from the fact of its sending the temperature up to 105° F. within four hours, and another in which the rise of temperature is relatively slow, and often preceded by a depression due to shock. A distinct class of urethral fever, and one which scarcely merits the name, is that which is met with in the cases, referred to above, of suppression of urine after operation. Finally, there has been described lately a combination of these conditions and others, to which the name of catheter fever has been given.

(1) FULMINATING URETHRAL FEVER.—In this the most violent form, the temperature

rises rapidly in four hours, on the average to 104°–105° F., and accompanying the rise of the pyrexia there are usually one or two severe rigors before it reaches its acme. The temperature commences to fall for two hours as quickly as it rose, but after that interval its descent is more gradual, and it reaches the normal again in about twenty to twenty-four hours. During its onset the patient feels sick and often has a violent headache, while during the rigor he suffers from the symptoms of that condition (*see* RIGOR), but usually, soon after the temperature begins to fall the unpleasant symptoms gradually disappear.

(2) The second variety of urethral fever is characterised by a gradual rise to 101°–102° F., in about twenty-two to twenty-four hours, having been preceded for eight to ten hours by a fall below the normal level. The final fall of temperature from the acme is nearly equal in time to the actual rise—viz. about twelve hours, so that the whole course is of about thirty-three to thirty-six hours' duration. Rigors occur at the usual point in the rise of temperature, but are not so frequent as in the first variety, and the constitutional symptoms are not so severe.

(3) Urethral fever, occurring in cases which are attended with suppression of urine, must not be regarded as belonging to the same category of 'fevers' as the two first described, for the reason that the condition of the patient is not a simple one. In fact, it is impossible at present to distinguish what of the rise is due to the operative measures, and what to commencing interstitial nephritis, &c. As a rule, the temperature curve is that of continued fever, varying from 100°–102° F., and falling gradually for twenty-four to forty-eight hours before death, when it is frequently subnormal. The curve resembles that of traumatic fever far more than that of typical urethral fever.

(4) CATHETER FEVER.—Under this term, Sir Andrew Clark has drawn attention to the way in which urethral fever is frequently followed by septic infection. He divides the clinical history of these cases into four stages—(1) Reflex irritation of the nervous system (*see* foregoing remarks); (2) disturbance of general metabolism, especially in the kidney; (3) septic infection begotten autogenetically or deuterogenetically—i.e. inside or outside the body; (4) the effect in the vessels of the urinary tract upon the metabolic processes, produced by suddenly drawing off the water from a distended bladder.

In this article, the relation of urethral fever to subsequent fatal septic processes is not touched upon, on account of the fact that at the time when pure urethral fever is started by instrumentation, the introduction of septic material, which may or may not develop in two or three days in the bladder, is very likely to happen. Cases in which it does so are referred to under NEPHRITIS; PYELONEPHRITIS.

Between the varieties just described (excepting 'catheter fever') of fever following instrumentation of the lower urinary tract, there are transition cases which bridge over the intervals between the groups formed out of averages, minute differences of detail in treatment, constitution of the patient, &c., obviously affording reason for the multiplication of forms.

Prognosis.—Favourable, if secretion by the kidney is found to be undisturbed. Extremely unfavourable, in proportion to its development, if the secretion of urine is checked or diminished, with excessive blood-staining. More or less unfavourable if the temperature is not normal again in forty-eight hours, since a continuation of the pyrexia will then suggest the extreme probability of nephritis having been lit up.

Treatment.—The most successful treatment of urethral fever is that which is based on the neurotic theory. It has been known for a long time that quinine and morphia, administered prophylactically, prevent the development of fevers arising from many causes, and among others urethral fever especially. Before, therefore, a patient is operated upon for stricture, &c., he should be treated for two to three days with Quinæ sulph. gr. iij., and Liq. morph. $\mathfrak{m}\mathfrak{v}$. every six hours. A quarter of an hour before the operation he should be given $\frac{1}{4}$ to $\frac{1}{2}$ gr. of morphia hypodermically, and be placed under ether for the operation.

During the operation he should be warmly clad, especially about the lower extremities, which are to be covered with drawers, socks, blanket, &c. In the event of a rigor, treatment indicated in the article on that symptom is to be followed.

Hot baths are of little use except in cases of SUPPRESSION OF URINE.

VICTOR HORSLEY.

URETHROPLASTY: shaping of the urethra. This term is used to denote operations for closing fistulæ or openings in the urethra. These operations may be practised in the perineal part, in the scrotal, or in the penile part of the urethra. They are most frequently needed to close

gaps in the last portion, that being the common situation of the destructive action of sloughing sores, or the result of arrest of development during fetal life. In the perineum, when obstinate fistulæ remain open, the tissues are nearly always greatly indurated and of low vital power; so that failure to get union of the margins of a fistula after bringing them together is very common, and several attempts must often be made before success is attained.

In all these operations, great attention to detail and most careful management are requisite. It is absolutely necessary that no urine shall percolate over the wound during the healing process. To ensure the preservation of the fresh wound from defilement with urine, the patient should be of an age when he may be readily taught to empty the bladder himself by a catheter, to be introduced every time urine is voided and before every evacuation of the bowels. This plan of preventing access of urine to the wound is much preferable to that of the retained catheter, by the sides of which the urine is apt to escape, when the instrument has been worn for more than two days. During the first twenty-four hours the catheter may be tied in, to allow the patient to recover his self-possession after the anæsthetic and for the soreness to diminish. But thenceforth the urine should be drawn every four hours by the patient himself. Should the patient be too young to be trusted with the catheter, it must be regularly drawn for him by a nurse, trained beforehand to use the catheter on the patient himself. While the catheter is worn, it should be plugged or its end connected with a foot or so of india-rubber tubing, so that the urine may be led away from the neighbourhood of the wound. It is also essential to success that the edges of tissue to be united shall be kept in close apposition without strain, that the circulation of blood through them may be free and continuous. If the circulation is hindered, either by dissecting too thin a flap of skin and thus dividing the nutrient blood-vessels, or by constricting them afterwards with tightly drawn sutures, the flaps do not unite, but slough away, leaving the opening larger than before.

Before operating, the patient must be prepared by invigorating his health with rest, attention to digestion, stay at the seaside or in fresh country air, regular use of hip-baths, and thorough dilatation of a stricture if there be one in the urethra. Any impediment to the outflow of the urine, until the wound is firmly consolidated,

would drive the urine against the scars of the united edges and cause them to give way. When the patient is freed from irritation of all kinds, the operation may be undertaken.

When the fistula is situated in the perineum, before the incisions are made, a No. 20 or No. 22 (No. 12 English scale) flexible catheter may be passed to the bladder and tied in, being plugged after the urine has been withdrawn. Then, the track of the fistula should be thoroughly cleared of the old cicatricial membrane that lines it with a sharp scalpel, and the surfaces be brought into apposition as nearly as possible along their whole length, from the urethra to the skin, by the quill suture or the button suture. The edges should be closely united by fine catgut or silk stitches set near together. If there be tension on the stitches through the induration of the parts, the skin may be loosened by incisions carried parallel with, but at a distance from, the line of the closing edges. These parallel cuts ultimately close by granulations. The line of sutures may be protected with a coating of collodion, and then dressed with iodoform and iodoform wool.

In the scrotal portion incisions may be more freely practised; the edges, besides being thoroughly pared, should be dissected away in thick flaps, and their raw surfaces held in apposition over the gap by wire and button or clamp sutures, while their edges are closely joined with numerous fine sutures of silk. The sealing with collodion and the preliminary introduction of the catheter should be practised in these cases also.

In penile fistulæ or congenital defects of the urethra, the thinness of the tissues that can be used for closing the aperture requires very delicate handling and careful adjustment, lest the flaps that are formed by dissection be strained or so injured that they throw out no reparative material at their points of junction. Not infrequently only part of the gap is closed at the first operation, the remainder being united by one or more repetitions of the paring and stitching process. Should this be necessary, sufficient time—two or three months at least—should be given between each operation to enable the parts already joined to establish the circulation through a plentiful system of blood-vessels. If the second operation is undertaken too speedily, the flaps, being ill-supplied with nutrient vessels, will slough and probably undo some of the union already obtained.

Several operations have been devised for closing the gaps, but many of them are liable to the objection of producing a troublesome stricture. In those plans where the raw surface of the flaps is turned inwards at the part to be covered, this inner surface is slow to heal, and does so by granulation, cicatrization, and contraction. The contraction must be kept open by sounds; the passage of which excites irritation and excoriation from time to time. This objection attaches to both of Nélaton's methods. By one of his plans the edges of the aperture are first pared, and then, transverse incisions through the skin having been made half an inch or more distant from the fistula—one in front, the other behind it—the knife is slipped underneath the skin, to separate it from the subjacent tissue, for half an inch all round the aperture. The skin which is thus freed is lifted away from the penis, and the edges of the fistula are drawn together by a pin and twisted suture. If the catheter be regularly employed and all urine drawn through it, the granulations growing from the large under-surface close the fistula in the urethra, and the gap in the skin unites quickly if not irritated by percolation of urine. The danger here is that the knife may be carried too close to the surface of the skin, and by dividing its blood-vessels, cause it to slough after the operation. Nélaton was also successful with another plan, by which, after paring the orifice, he dissected the skin freely around it by introducing the knife under the skin through two lateral incisions, parallel to and at some distance from the raphé; this done, he stitched up the orifice of the fistula in the area of skin separated from the cellular tissue, and passed a slip of india-rubber underneath it, to protect the joined edges from urine during their granulation, the urethral fistula being closed in the same way as in the first method.

The orifice which terminates the urethra before the operation is often extremely narrow; and before closing the gap, care must be taken to pare away the edges freely, to ensure a sufficiently wide passage at this point afterwards.

Legros Clark and others have devised, and used with success, methods by which flaps of skin dissected from the penis around the aperture have been securely adjusted over it, and union obtained. When the orifice is small, all these plans are successful, but when a large gap is to be covered, as in cases of hypospadias, they usually fail. Success has often followed the first attempt, if the precaution is taken to make a

perineal aperture in the urethra behind the fistula, through which the urine may be drained from the bladder until the plastic operations have thoroughly closed the fistula in front. When this repair is complete, the urine may be withdrawn through the natural channel, and the perineal outlet closes spontaneously.

In cases where the urethra is open quite or nearly to the peno-scrotal angle, the method devised by Anger of Paris has been successfully employed by the writer. In these cases, there is the additional complication of curvature of the penis during erection. Fibrous bands, placed across the corpus spongiosum near the urethra, prevent proper dilatation of the erectile tissue, so that the glans is bent during erection towards the scrotum instead of being directed upwards. In attempting a cure of such a case, it is necessary first to divide the fibrous bands which draw down the glans during erection, and when the wound thus made has healed, to proceed to the prolongation of the defective urethra. If the organ be examined, a furrow will be traced along the mesial line from the actual termination of the urethra to the apex of the glans. This is the roof of the urethra, in which, at the proper situation, the furrow is deepened to form the fossa navicularis. On each side of this furrow the loose skin of the penis is raised into a narrow ridge—each ridge being half of the raphé of the perfect organ. Anger, in order to provide a suitable surface for the continuation of the urethra, and also to prevent the formation of a cicatricial stricture, so cut his flaps that one was turned inwards, with its epidermic surface towards the urethra, its raw surface having been turned outwards. This raw surface was again covered by a second flap brought over it from the other side, and attached closely to it by rows of stitches applied on each side of the urethra, as will be presently described. By this contrivance a surface of skin, not raw tissue, was turned towards the urethra, and a large raw surface exposed and applied to a similar raw surface, to which it united by granulation. Great security against failure of union was thus obtained, and an epithelial lining provided for the urethra.

In carrying out this method, the penis is steadied on a large sound, No. 25 or 26, after the margins of the urethral orifice in front of the scrotum have been pared freely. One incision is made across the penis through the skin opposite to the glans penis, and, parallel to it, another three-quarters of an

inch behind the orifice of the urethra. Between these transverse cuts two flaps are formed: one by an incision carried along the penis close to the raphé at the side of the furrow, and dissected outwards for half or two-thirds of an inch. This will form the outer flap when in position. Next, a parallel longitudinal cut is carried along the penis between the transverse ones, but two-thirds of an inch away from the mesial line. A flap is then formed by dissecting up the skin towards the raphé. When this flap is formed, it is turned over the sound, so that its epidermic surface lies against the metal. Its corners are then fixed by two points of fine catgut or silk suture to the raw surface of the penis, at each end of the root of the covering flap first formed. The two flaps are compared and, if needful, trimmed to fit nicely, especially at the posterior end, where they overlie the urethral orifice. The upper flap being then held back, a close row of fine silver wire sutures is carried through the free edge of the inner flap and the cellular tissue of the penis close to the root of the upper or covering flap, so as to attach the inner flap closely in its place, the ends of the wire being led out through the upper flap at its root and left loose. The upper flap is then applied to the inner one, and the wires tightened by running over them split shot or short lengths of lead-tubing, which can be pinched round the wires. The ends of the flaps are carefully stitched to the scrotum behind the margins of the orifice, and also at the end near the glans at each side of the sound.

Finally, the free edge of the upper flap is fixed in place by some points of interrupted suture along its free border. This done, the edges are freely painted with collodion; the sound is withdrawn and replaced by a flexible catheter, which is worn for the first twenty-four hours, after which time it should be taken out and the urine drawn off at regular short intervals during granulation. The parts must be kept well covered with iodoform and wetted with cold boracic acid lotion, to prevent erection during sleep. Erection may also be hindered by large doses of bromide or of bromide and chloral hydrate. The bowels must be kept quiet by opium, and the patient remain as still as possible in bed. At the end of the fourth or fifth day the sutures should be examined, and any that are cutting their way out removed at once, their punctures being drawn well together by collodion. In the course of seven or nine days the remainder of the sutures are removed, and at the end of a fortnight the

patient is able to sit up in bed and gradually resume his active habits. The catheter should be used for emptying the bladder for three or four weeks. See HYPOSPADIAS.

BERKELEY HILL.

URETHROTOMY. — (Cutting the strictured part of the Urethra.) — The cases of stricture for which urethrotomy is most suitable are the following: strictures of the meatus urinarius; strictures of the penile portion of the urethra in front of the peno-scrotal angle, particularly narrow bands or 'bridle' strictures; strictures of the bulbous portion when composed of thick masses of fibrous tissue; and strictures of ordinary density, if dilatation by the passage of bougies or sounds excite irritation and febrile reaction in the patient.

In persons who suffer from rigors after a sound or bougie has been passed, complete division under anæsthetics commonly causes no rise of temperature and quells the irritation at once, if the precautions to be afterwards described are taken. Strictures which contract rapidly when enlarged by gradual dilatation are best treated by cutting; so also are strictures complicated with urinary fistulæ. Again, in young persons whose disease has not existed long enough to alter the condition of the kidneys, cutting is admissible for a stricture that should be simply dilated in an elderly man whose kidneys have undergone considerable degeneration. The young man desires to lead a more active life than he whose kidneys have been seriously diminished in excretive power can possibly do. Again, urethrotomy affords a longer interval of freedom from contraction than does any other plan of widening a stricture; and if the after-management of the stricture be regularly carried out—a necessity in all cases, whatever be the plan of treating the stricture—the patient may enjoy many years of freedom from disturbance of the urinary organs.

The patients for whom urethrotomy is not necessary or not suitable, are those whose contractions, being of only short duration, are formed by areas of inflammatory congestion rather than by development of fibrous tissue; such contractions are usually dispersed by gradual dilatation. Strictures also do not need urethrotomy which give way readily under gradual dilatation and do not contract again during the process, nor return rapidly after a sufficient width has been restored to the urethra. The result in such case is satisfactory, and obtained

with less inconvenience by interrupted dilatation than by cutting.

Several methods are followed for treating strictures by cutting. They may be arranged in two groups—those which attack the stricture from within the urethra—*internal urethrotomy*; those which attack it from the surface of the body—*external urethrotomy*.

INTERNAL URETHROTOMY may be performed by instruments which cut the stricture as the knife advances along a guide towards the bladder, from before backwards; or, by one where the knife, protected by a shield, is first carried through the stricture, and then exposes its sharp edge to the stricture as the instrument is withdrawn from behind forwards. By cutting from before backwards narrower strictures can be divided than by the second method, where the instrument most generally employed for this purpose—Civiale's—cannot be used until the stricture is widened sufficiently to allow the knife and its shield to pass. The requisites of a urethrotome for cutting from before backwards are—(1) a guide through the stricture to the bladder, (2) a sharp edge, which, passed along the urethra under a shield, can be protruded by the operator at any part and as deeply as he desires to cut; (3) means for steadying and tightening the fibres to be divided before the knife is passed across them. The last requirement is an essential condition of a good urethrotome, in consequence of the toughness of the fibres themselves and the mobility of the parts in which they are formed; conditions that render proper division of them extremely difficult unless the part to be cut is kept taut while the sharp edge is carried across it. The edge of the knife also cannot be too sharp to divide the dense tissue of a stricture.

In the experience of the writer, Maisonneuve's urethrotome, as improved by Teevan, meets these requirements tolerably well. In the Maisonneuve-Teevan urethrotome, the guide consists of a fine, hollow staff, which can be passed through very narrow strictures by means of a filiform guide-bougie, to the end of which it can be screwed after the bougie has reached the bladder. Along the hollow staff a stylet is run, carrying in front of it a triangular shield, which, fine at the apex, widens gradually to three-quarters of an inch at the base. This inclined edge is pushed to the stricture at the upper surface of the urethra, tightening and steadying it before the triangular knife, which can be protruded beyond the shield, attacks the unyielding

fibres. When the opposing fibres are sufficiently divided, the shield travels onward to the bladder; and, in withdrawal, its wide base catches against any insufficiently divided fibres against which the knife's sharp base can be brought, and thereby ensures their thorough section.

Another urethrotome that complies with these requirements is the 'Wedge-Dilator' of the writer. It is composed of the following parts:—First, a narrow split sound, calibre of No. 8 of the millimetrical scale (No. 2 English), that can be guided through narrow tortuous strictures by being attached to a filiform guide-bougie, previously passed to the bladder. Second, a wedge that runs in dovetail grooves between the halves of the split sound. In this wedge is concealed a knife that can be protruded between the halves of the split sound, when the stricture-tissue prevents their separation sufficiently to allow the wedge to pass on. The wedge, pushed up to the situation of the stricture, in separating the halves of the split sound tightens and steadies the stricture thoroughly, while the knife divides it to the width required by the wedge to pass along. If a wedge be chosen that will expand the urethra to its full natural capacity, the cut made by the knife divides the stricture to that extent, but does not pass beyond the stricture into the vascular erectile tissue external to it. The knife can be applied either to the upper or under surface of the stricture as may be preferred.

Instruments which cut from behind forwards—i.e. after the knife in its shield has passed behind the stricture—steady the fibres to be cut by pulling forwards the parts which attach the urethra to the pelvis, as the bulbous end of the urethrotome is drawn out. The stricture is pulled on by the instrument until the cut gives free passage to the bulbous shield and knife, separated from each other. But reliance cannot be placed on the simple straining of these attachments to ensure perfect division of the stricture-tissue. A Civiale's, or any other urethrotome which cuts from behind forwards, is very apt to wriggle its way through a stricture without properly severing its fibres; and, to meet this difficulty, the knife is often carried more deeply than is otherwise necessary. There is another objection of greater importance to the method of cutting from behind forward. It is this: if an incision be made through a thin layer of fibrous stricture-tissue into the erectile tissue, in the belief that a tight stricture with a thick layer of fibrous tissue exists, there is greater danger of free hæmorrhage,

and of septic absorption through the vascular tissue thus laid open. This risk is less when cutting from before backwards, and the writer prefers to begin at the meatus urinarius and divide only such obstructions as prevent the progress of the wedge-dilator in its advance towards the bladder, thus avoiding the risk of cutting into the erectile tissue.

Most of the instruments used for cutting from behind forwards consist of a straight or slightly curved staff, terminated by a bulb or 'swell.' This swell is the shield containing the knife. By means of a contrivance at the handle, the distance to which the cutting edge is thrown forwards from the shield can be regulated. The operator first passes the urethrotome through the stricture, then drawing the instrument outwards, exposes the knife at the posterior limit of the stricture, and with a slightly sawing motion cuts his way along the stricture. In doing this, he places the forefinger of his other hand against the skin lying over the stricture, and judges of the completeness of the division partly by the cessation of resistance to the progress of the knife, and also by the sensation which the near approach of the knife to the finger gives him. The success of the operation and the avoidance of dangerous complications depend greatly on the precision with which the fibrous tissue is divided and the normal vascular or erectile tissue outside it is untouched. Hence, by whatever method the cut be made, the operation is one requiring great nicety of manipulation and caution on the part of the operator.

Certain complications may follow internal urethrotomy if incision be carried beyond the fibrous tissue. Among them are perineal abscess, extravasation of urine, copious hæmorrhage, orchitis, acute suppurative nephritis, and septicæmia. But if the operation is confined to cases suitable for this method of treatment, and the necessary precautions are taken, the occurrence of dangerous complications is very rare. Before the patient is subjected to urethrotomy, his general condition must be free from febrile disturbance. The kidneys must be working properly; this is shown by the urine being acid, not much loaded with mucus, free from albumen or almost so, and containing urea in the proportion of not less than two and a half or two per cent. The urethra must not discharge pus; any urethritis that may be present must be cured before the operation is performed.

To ensure favourable results, the after-treatment is also of great importance. The writer's present custom, which he has followed for several years, is, after incising the strictures, to test the width of the canal by passing a wedge of the size of No. 27 of the millimetrical scale after the knife, and then to withdraw, by a No. 24 silver catheter, any urine that may be in the bladder. No catheter is tied in the urethra, and the patient is ordered to refrain from micturition for seven or eight hours, or as long as the call is not urgent. The secretion of urine for some hours after the operation is small because, to prevent vomiting from the anæsthetic, the patient has fasted for five hours before the operation, and after it takes only a few spoonfuls of ice or iced milk for a like period. In six or eight hours the wound is protected by firm clot and plastic fibrin. When the bladder must be emptied, the patient is put into a hot hip-bath, and passes urine while in the bath. The urine is thus voided without spasm of the perineal muscles; and the incision, protected by clot and fibrin, is not torn open and exposed to the stream of urine. If the urine flow off without disturbing the protecting clot, very little if any pain is felt during micturition and no reaction ensues. If pain has been felt, it is well to repeat the hot bath at the second act of micturition.

The nurse should be directed to take the temperature of the patient before he passes urine, and at half an hour and an hour afterwards. In the cases of reaction after micturition, the thermometer will show a slight rise before the patient feels any malaise, chill, or shiver. Immediately a rise is detected, a soothing draught or antipyretic should be given, such as twenty minims of tincture of opium in an ounce of brandy and a little hot water, into which five or eight grains of quinine are put. The temperature must be carefully noted every two hours, and an important elevation combated by repetitions of the quinine at intervals of three hours. But, if precautions are taken to prepare the patient for operation and to avoid strain of the urethra in micturition during the first twenty-four hours, reaction seldom occurs, and the temperature keeps below 99° F. throughout.

It is indispensable that the patient lie in bed continuously for at least ten days, and keep his room for fourteen days. He must not even get up to the night-stool for the first three days after the operation. To conform to this condition the more easily, the bowels should be

well cleared before the operation and the patient lightly fed afterwards, that the bowels may not need to be cleared for three or four days. At the end of this time a dose of castor-oil or blue pill and draught of sulphate of magnesia may be taken, to ensure defæcation taking place promptly and without straining. On the eighth or ninth day a bougie, No. 24 or 25, should be slowly and gently passed through the stricture, no instrument having been introduced after the operation until then. This period of rest to the incision is of the highest importance to avoid pain, bleeding, and suppuration of the wound. If the wound heal by suppuration, the after-contraction is always much more speedy than when it heals by simple union. On the tenth or eleventh day, the patient may be taught to pass the bougie himself by letting him push it slowly and gently to the bladder. A repetition of this lesson on the thirteenth day usually suffices, and the patient is allowed to get about at the end of the fortnight. If pain and soreness attend the passage of the bougie, the temperature must be carefully watched, as was done after the operation. On the approach of pyrexia, warm baths, fomentations, &c., must be employed to allay local irritation, while the febrifuge draught is again prescribed. Before leaving the surgeon's care, the patient must be impressed with the necessity for regularly passing the bougie at intervals increasing in length from twice weekly to once in three months or once in six or twelve months, according to the rapidity with which signs of shrinkage come on.

Dangerous Complications. — Copious hæmorrhage is most frequent immediately after the incision, if the knife have cut more than the stricture itself; but it may occur at the end of a week after incision, even before a bougie has been passed. In such cases the knife has been carried too deeply, and the erectile tissue has been wounded. It is rarely dangerous, and is controlled by passing through the stricture a lithotomy tube or one made of hard rubber, around which the urethra can be compressed, and the bleeding vessels closed till a coagulum is formed, when the compressing apparatus may be removed. When the bleeding point is at the bulbous portion of the canal, a crutch, invented by Otis of New York, can be fastened to the knees and ankles, and made to press strongly on the perineum. Renal congestion, denoted by rigors, diminished secretion of urine, &c., may follow the incision itself, or may occur if a bougie be incautiously thrust through the granulating

area of the wound. The most common consequence of too hasty a use of the bougie is epididymitis. Nephritis and septicæmia are treated in the manner appropriate to these affections when arising from other causes. Perineal abscess and extravasation of urine require early drainage and great cleanliness in dressing. It must be again repeated that, when sufficient care has been taken in the preparation of the patient and in the performance of the operation, these complications do not occur.

For widening very narrow, tortuous strictures, along which a bougie or catheter can be passed only part of the way, or when the presence of a narrow anterior stricture hampers the surgeon in the treatment of a second deeply placed one, Lund of Manchester has invented a useful instrument. A grooved and very narrow director projects for two and a half inches beyond a cylinder of the size of No. 20 of the millimetrical scale. This director is passed as far as it will go through the stricture, and then a stylet, carrying a little knife that projects one-twentieth of an inch above the director, is thrust forwards from the cylinder by a thumb-spring in the handle. This cuts the anterior stricture sufficiently to allow an instrument to traverse it and approach the deeper one with freedom. This plan is occasionally a useful resource; but it needs great care and nicety in execution, that the instrument may not enter a false passage, and incise that instead of the urethra.

When the stricture is very dense and of long standing, the bladder is sometimes so affected with chronic cystitis that nothing except the restoration of free evacuation will cure it. But the trickling of pus, often of ammoniacal urine also, over the fresh wound of the incision excites irritation and suppuration therein, with unfortunate effect on the stricture. A procedure revived by Reginald Harrison of Liverpool is very useful in these cases—drainage of the bladder through a perineal opening into the urethra behind the stricture—so that no urine, pus, or mucus shall pass over the stricture-incision until it has had time to heal.

EXTERNAL URETHROTOMY, dividing the stricture from without, is practised upon a guide passed through the stricture to the bladder—Syme's operation. When it is not possible to pass a staff to the bladder, the stricture may be reached by opening the urethra in front of it, laying bare its mouth and passing fine directors through it, on which the knife which divides the fibrous tissue can be guided along the urethra—

Wheelhouse's operation. Lastly, it may be dealt with by opening the urethra behind the stricture—Guthrie's perineal section—and cutting forwards through the stricture to a sound passed down to its anterior end.

The cases for which external division is appropriate are those in which the perineum is thickened and hardened by inflammation or cicatrices, and the urine escapes, wholly or in part, from the dilated urethra behind the stricture through one or more fistulæ. The very rare cases, also, in which repeated patient trials fail to introduce an instrument along the urethra to the bladder, must be treated by a perineal opening.

Syme's operation; or that in which a grooved staff can be passed through the stricture to the bladder. The staff used in these cases has at the last three inches—the curved part—the calibre of No. 8 of the millimetrical scale (No. 2 English). This part is grooved on the convexity; beyond the grooved part to the handle, the staff enlarges by an abrupt shoulder to No. 18 or 20 (No. 10 to 12 English), and the groove is prolonged by a notch through the shoulder, but no farther. This staff is passed into the bladder, and the patient is put in the lithotomy position. The surgeon sits down opposite the perineum, and, with the left forefinger inserted into the rectum, feels for the curve of the staff in the perineum, and also that its position in the urethra is correct. An assistant holds the staff steadily, pushing its convexity downwards towards the surface, that it may be the more easily met by the knife. The surgeon then introduces the point of a scalpel, the cutting edge being held forwards, through the skin and fat at a point one inch in front of the anus and exactly in the mesial line of the body. The left forefinger then explores the incision for the staff; if felt, the finger is held steadily against the staff while the scalpel is slid along the nail till its point penetrates the urethra, which is usually not indurated at this part, and rests against the staff in its groove, the edge of the knife being forwards as before. The knife, steadied by the left forefinger behind it, is then carried forwards, the point scraping along the groove of the staff until the shoulder of the staff is reached. The whole of the indurated tissue of the stricture being cut, the knife is laid down and a small gorget with a narrow tapering point, fine enough to run in the groove of the staff, is passed through the wound to the bladder. When this is reached by the gorget, the staff is withdrawn and a flexible or celluloid catheter, No. 20 or 22

(No. 12 English), is passed along the urethra from the meatus, and, guided by the gorget, traverses the incised part of the urethra, and easily reaches the bladder. The gorget is removed, the catheter secured, and the bladder emptied. The catheter is worn three days, then withdrawn, and a No. 24 or 25 steel sound is passed every third or fourth day until the perineal cut has closed. *Fistulæ*, if tortuous or containing collections of pus, must be incised, that the matter collected in them may drain off freely. Usually, when urine is no longer forced into them by the efforts of the patient to empty the bladder, *fistulæ* close up readily.

It is necessary that the patient be aided in his recovery by rest in bed, good food, sea air, &c., as the bodily condition is often much exhausted by irritation of the stricture and the abscesses which formed before the operation was performed.

A stricture divided externally will, if neglected, shrink again as certainly as it does after any other method of treatment. Hence the patient must be trained to use a maintaining bougie regularly after he is dismissed from the surgeon's care.

External urethrotomy by opening the urethra in front of the stricture, now generally practised by *Wheelhouse's method*, is a very valuable one in the rare cases when, though urine escapes along the urethra, no instrument can be passed through the stricture. The patient is put into the lithotomy position; a straight staff, grooved on one side, with its beak turned up as a blunt hook at the other side, is passed along the urethra to the stricture, and held steadily with the groove directed towards the surface. The operator feels for the tip of the staff, and, making in the mesial line an incision an inch long through the integuments, exposes the tip of the staff at the bottom or posterior end of this incision. He then completes the division of the urethra for the length of the incision, by running his knife along the staff. The sides of the incision are seized with hooked forceps and held asunder by assistants, and the staff is turned round, that its hook may catch in the upper end of the incision. The interior of the urethra is carefully sponged and the mouth of the stricture sought for. It is usually discovered easily, and a fine probe-pointed director may be carried through the stricture to the bladder. On this director the stricture may be cut towards the bladder with a long narrow knife or tenotome. When the passage has been thus widened, a small tapering gorget, of which the beak fits into the groove of the director, is carried

to the bladder. The director is withdrawn, the hooked staff and forceps are removed, and a flexible catheter, passed along the urethra, is guided to the bladder by the gorget and fixed in place. The remaining treatment is that employed in Syme's method.

Perineal Section of the membranous portion of the urethra must be done when no guide can be carried to the bladder. By this operation access is obtained through a cellular interval between the last portion of the rectum and the bulb of the urethra. Here, in the mesial line of the body, no important structures intervene between the urethra and the surface. The patient is directed to hold his urine, if possible, for some hours before the operation, that the bladder may be charged and its neck and the distended membranous portion of the urethra found more easily at the time of operation. The surgeon has at hand a bistoury, probes, probe-pointed directors, artery-forceps, sharp and blunt hooks, No. 20 (12 English scale) silver catheter, tapering gorget, sponges, tapes, &c. The patient is put into the lithotomy position, and the surgeon begins by passing the left forefinger into the rectum to ascertain the precise position of the bowel, and to draw it slightly backwards. A puncture through the skin, half an inch in front of the anus and precisely in the middle line of the body, is made with a small sharp-pointed bistoury, the edge being turned forwards, and an incision is carried directly forwards for an inch and a half. When the skin of the perineum is much indurated, a short transverse cut may be made also to give freedom to the further steps of the operation. With this exception, the line of the cut must be carefully kept in the mesial line throughout, or the urethra may be missed and much mischief done. The left forefinger being still in the rectum, the incision is deepened to one inch. If the patient cough or strain, the urethra may often be distinguished when distended by the escape of urine into it from the bladder; in this state its puncture is easy. If the urethra remain collapsed, the point of the knife is thrust backwards a little and the patency of the urethra tested by a probe, and by the left forefinger exploring the wound. If urine escape through the puncture, difficulty is at an end. A director is passed to the bladder and along it the tapering gorget, over which the urine escapes copiously. The track to the bladder being thus assured, the stricture may be dealt with.

A catheter is passed along the urethra from the meatus to the contracted part, and then the gristly tissue is cut cautiously, in a forward direction from the incision, until the catheter can be brought to the surface of the gorget, by which it is at once guided into the bladder, where it may be tied in and the gorget withdrawn. Sometimes when the urethra has been opened behind the stricture, a fine probe or probe-director can be carried from the posterior incision forwards through the stricture, and the division of the stricture by means of its guidance is much facilitated. Cases of traumatic stricture occur, in which the induration of the perineum by cicatricial tissue extends as far as the neck of the bladder, access to which can be obtained only by slow penetration with repeated cautious cuts in the middle line, until a probe or director can be carried into the bladder, when the division of the stricture may be performed in the way already described. In these cases care is necessary to avoid the rectum in the progress of the knife to the neck of the bladder. Usually, the hæmorrhage is not great, because the naturally vascular structures have been replaced with fibrous tissue. After the operation, the patients recover slowly with a urethra that is very prone to shrink, so that the daily use of the sound or bougie is usually needed to keep it open.

Subcutaneous Urethrotomy is a term applied to division of short ring-like strictures in the penile portion of the urethra. A small grooved staff, straight and about six inches in length, is passed through the stricture. The staff and penis are well steadied by an assistant while the operator, passing a fine sharp-pointed tenotome through the skin and stricture to the staff, carries its point up and down until the stricture is thoroughly divided. The little skin-puncture is then sealed with collodion; a No. 16 (No. 8 English) catheter is passed to the bladder and worn for twenty-four hours to prevent the flow of urine into the cut for that space of time. The external aperture having healed, the catheter is withdrawn and the urethra left at rest for six or seven days. At the end of a week, the dilating sound, No. 24 or 25, should be passed every third day for some weeks until the incision has healed. This method of cutting strictures has been applied to the treatment of long and deeply placed ones; but its success has been doubtful in such cases. When employed for short penile strictures, it has proved a very simple and successful operation. **BERKELEY HILL.**

URETHRO-VAGINAL FISTULA. *See VAGINAL FISTULÆ.*

URINARY DEPOSITS.—The substances which form urinary deposits in health make up, when exaggerated in quantity (and others added), the sediments of disease. In forming a list, therefore, it will be best not to regard this or that deposit as notably pathological or the reverse, but to arrange them according to their composition, and as to whether they are deposited from neutral, acid, or alkaline urine.

Thus, the following *simple, unorganised, chemical substances* are deposited from—

A. Neutral Urine.

1. Oxalate of lime.

B. Acid Urine.

2. Uric acid.

3. Urates.

4. Oxalate of lime.

5. Tyrosin.

6. Cystin.

C. Alkaline Urine.

7. Ammonio-magnesian phosphate.

8. Magnesian phosphate.

9. Phosphate of lime.

10. Urate of ammonium.

11. Carbonate of lime.

12. Oxalate of lime (if alkalinity is weak).

1, 4, 12, *Oxalate of lime*, appears as a slight white sediment in urine of persons apparently healthy, especially in the tropics (India, &c.). *Tests*—(a) Microscopic: Seen as octahedral crystals, rarely spheres, dumbbells, and prisms; (b) Chemical: Insoluble in acetic, soluble in hydrochloric acid. *Importance*—Slight, usually due to vegetable diet; may, however, be a symptom of general metabolic derangement known as the oxalic acid diathesis.

2, *Uric acid*, appears usually as a brick-red sandy deposit, which clings to the bottom of the vessel, and has long been known as the 'lateritious deposit.' *Tests*—(a) Micro.: Seen as 'whetstone' crystals usually, the shape being made more characteristic if the acid is allowed to recrystallise from its solution in a drop of hydrochloric acid; frequently the bright-red crystals form great rhombic bundles, in which the whetstone outline is more or less lost; (b) Chem.: Heat *gently* in a capsule with a drop of nitric acid until a solid residue remains, which, moistened with a drop of ammonia or other alkaline solution, gives a purple or blue colour (murexide). *Importance*—Considerable if present in quantity, a symptom of so-called uric acid diathesis; is an indication of (1) great tissue-waste, (2) excessive

ingestion of nitrogenous food, (3) imperfect elimination of nitrogen by excretory organs.

3, *Urates*, usually of soda, more rarely potash, for urate of ammonium see below; appear as a white or pink light precipitate, falling as the urine cools. *Tests*—(a) Micro.: The heavier urates are frequently amorphous, and so are seen as fine granules which form earthy masses; sometimes, rarely, they crystallise as rhombic needles; (b) Chem.: Soluble on warming; dissolve in acid; obtain uric acid test, for which see above. *Importance*—Same as uric acid; see above.

4, *See 1.*

5, *Tyrosin*, forms a greenish-yellow precipitate if present in quantity. *Tests*—(a) Micro.: Seen as sheaves of needles, rarely in spheroidal masses; (b) Chem.: Scarcely soluble in hot water, soluble in alkalis. If the watery solution is boiled with a little Millon's reagent (mercuric iodide dissolved in potassic iodide), the fluid becomes dark red, and a red precipitate falls. *Importance*—Great, as indicating usually acute atrophy of the liver, and, at any rate, great tissue-destruction, since it appears in the tissue in extreme cases of smallpox, typhus, and phosphorus-poisoning. Under these circumstances, it is accompanied usually by leucin, which may share in producing the above-mentioned deposit, and which is recognised, at any rate, by its microscopical characters of colourless spheres of colloidal appearance.

6, *Cystin*, a rare substance, and which, when present in urine, seldom produces a definite deposit, but colours the urine a greenish-yellow. *Tests*—(a) Micro.: Seen as colourless hexagonal plates, not to be confounded with yellow hexagonal plates of iodoform; (b) Chem.: Cystin is precipitated from its solutions as white crystals, which are soluble in ammonia and recognisable under the microscope. *Importance*—Only as possibly leading to the formation of calculi.

7, *Ammonio-magnesium Phosphate*.—This salt, the well-known triple phosphate, is of the greatest clinical interest, forming a white deposit from ammoniacal urine. *Tests*—(a) Micro.: The crystals of this salt form regular prisms with trough-like ends (coffin-lid crystals), which form masses in the urine, entangled in mucus, &c.; (b) Chem.: The crystals are soluble in acetic acid, &c., but their form is sufficient for diagnosis. *Importance*—The formation of this deposit in the bladder or on the surfaces of wounds made for opening that viscus, when the urine is ammoniacal, leads to the

production of thick coatings of friable deposit, held together by mucus. These coatings may assume the proportions of calculi, and produce similar symptoms.

8, *Magnesium Phosphate*, a white salt found with No. 7, forming a floccular sediment. *Tests*—(a) Micro.: Seen as rhombic plates under the microscope; (b) Chem.: These crystals gradually dissolve in a 20 per cent. solution of commercial carbonate of ammonia, whereas the triple phosphates are unaltered.

9, *Phosphate of Lime*.—(1) The tribasic salt forms a green iridescent scum on the surface of urine (and calculi—Shattock). *Tests*—(a) Micro.: Seen as crystalline plates; (b) Chem.: Soluble in acetic acid (see No. 7) without effervescence. (2) The neutral calcium phosphate forms rosettes of needles or pointed rhombic prisms.

10, *Urate of Ammonium*, is mixed with the phosphatic deposits from ammoniacal urine. *Tests*—(a) Micro.: Seen as spheroidal crystals furnished with spikelets; (b) Chem.: Soluble in potash with evolution of ammonia. Urate detected as above; see No. 3.

11, *Carbonate of Lime*, mixed usually with the earthy phosphates (see No. 9). *Tests*—(a) Micro.: Usually seen as spheroidal masses, especially in presence of any colloid substance; (b) Chem.: Easy to detect by the effervescence on adding acetic acid to the crystals under the microscope.

To the above list may be added as a rare curiosity *sulphate of lime*, occurring as a white deposit in acid urine. *Tests*—(a) Micro.: Seen as acicular crystals and colourless prisms; (b) Chem.: They resist the action of weak acids.

So also *hippuric acid* may occur as a deposit. Care must be taken, of course, to note whether the patient is taking an excess of benzoic acid as food or medicine. Hippuric acid forms a crystalline sediment like the triple phosphate. It is soluble in hot water, and, being dried after treatment with nitric acid, gives a strong smell of nitrobenzol.

The remaining deposits for consideration are those which are formed by portions of the tissues of the urinary tract.

1. *Epithelium*.—Epithelial corpuscles of the urethra, bladder, ureter, and renal pelvis, and of the renal tubules, may be found distinct or massed together, and always possessing more or less characteristic shape, which enables them to be recognised as coming from a definite part of the tract. As a rule, the epithelium is undergoing fatty and granular degeneration, the

nucleus being obscured. It is customary to describe the masses of corpuscles which are derived from the renal tubules as casts, and then to classify them into—(a) blood-casts, (b) hyaline casts, and (c) epithelial casts. This is a practically useful division, and therefore is best retained, it being understood that no special means of production is assumed thereby.

a. Blood-casts are simply small clots expelled from the tubules, and we may find in other kinds of casts numerous red blood-corpuscles.

b. Hyaline casts are clear albuminous moulds of the tubules. How they are formed is a matter of theory, but as they are albuminous they may simply be coagulated exudation, or albuminoid material the result of albuminoid degeneration.

c. Epithelial casts—i.e. shedding of the epithelium of the tubules—may take place in parenchymatous diseases of the kidneys to such an extent as to occur in masses in the field of the microscope. Usually the masses are very degenerate, and often the outlines of the corpuscles are all fused together. The relation of the above-described casts to the various forms of kidney-disease is fairly constant, and, from what has been said, it will be understood that the desquamation of more or less perfect epithelial casts will occur in parenchymatous nephritis, that blood-casts will be seen in acute nephritis, and that fatty and hyaline casts accompany chronic disease.

2. *Mucus* is always present, more or less, as a tenacious cloud settling to the bottom of the glass; it may occur in such quantity as to form a thick ropy mass filling half the vessel. Microscopically it contains numerous 'mucus' corpuscles.

3. *Pus*, recognisable as a yellow, ropy sediment mixed with mucus. Microscopically, the fattily degenerated leucocytes, with breaking-up nuclei, are very characteristic. Chemically, the addition of potash makes the sediment excessively ropy, sticky, and sometimes lumpy.

4. *Semen*.—All the constituents of semen may occur in the urine after emission, &c. Thus, fully formed spermatozoa, spermato-blasts, and colloidal spheres have all been found, and are easily recognisable.

5. *Fragments of New Growths*.—Occasionally, portions of tumours of the urinary tract are found in the deposit. The commonest condition in which this occurs is a villous tumour of the bladder. A portion of the vascular stroma covered with epithelium may be detected by patiently searching the deposit, and especially if any

fibrinous shreds are to be seen in it. A shred of villous tumour is so characteristic as not to require detailed description. Next, epithelioma of the bladder may be discovered by finding quantities of greatly degenerated and distorted large epithelial cells, such as obviously come from the bladder. The diagnosis is here much more difficult, but a very accurate surmise can be made by a practised eye. Lastly, epithelial growths, cancers, &c., of the kidney shed typical cells (usually with blood-clots), and sometimes have thus confirmed a diagnosis.

Vegetable Parasites.—All kinds of fungi have been described as occurring in normal urine, but very grave doubt is always to be cast on such statements. There is only one condition known, and that imperfectly worked out, in which organisms (vegetable) have been found in acid urine. Roberts has described a form of bacilluria in which bacilli (resembling *B. subtilis*; see SCHIZOMYCETES) have existed in the healthy bladder during life. Passing from this point, it is, of course, a matter of every-day observation that all kinds of organisms—micrococci, bacteria, termo, &c.—grow readily in alkaline urine, and, by keeping up fermentation, cause the deposit of numerous salts.

Animal Parasites.—Among urinary deposits must be mentioned the ova of the Bilharzia worm, which has its habitat in the portal venous system, and which causes hæmaturia. The ova are found entangled in the deposits of blood-clot.

General conditions, such as chyluria, &c., which cause partial deposits, are not properly treated of in this article. See URINE. VICTOR HORSLEY.

URINARY FISTULA in the perineum commonly results from abscess, caused by urethral stricture in the ways described under PERINEAL ABSCESS. When abscess is the preliminary stage of the fistula, the collection of matter may communicate from the first with the urethra, or may form outside and open into the urethra afterwards. When the suppurating tract has no external opening it is termed a 'blind fistula.' Besides origin in the urethra, fistula may be caused by abscess in the prostate, by sloughing of the integuments over areas invaded by extravasated urine, or by the destruction produced by venereal sores. Again, fistulae remain sometimes after lithotomy or cystotomy, from the knife having been carried too deeply into the rectum (recto-vesical or recto-urethral fistula). Or,

a piece of calculus or other foreign body lodged in the urethra may set up abscess that terminates in fistula. *Fistulæ* are produced sometimes in the loin in connection with the kidney. See NEPHROTOMY.

Fistulæ usually open in the perineum near the scrotum, in the scrotum or sheath of the penis, but they may also terminate in the groin, above the pubes, at the nates, or in the upper part of the thigh. Usually limited in number to one or two, they may be numerous, even as many as fifty. Their orifices are commonly only the size of pin-holes; but, where there has been sloughing from extensive extravasation of urine, large gaps may be left by necrosis of the soft parts. The urine may escape during micturition as a drop or slight oozing from one or two of the orifices, or most of it may be voided through several openings, and trickle away like water through a colander.

The varieties of fistula may be arranged in four groups.

1. *Simple fistulæ*—that is, one or two canals running from the urethra to the surface, and affording a tolerably direct channel for the outflow of urine, when the urethra is blocked in front of them by a tight stricture.

2. *Fistulæ* which permeate a perineum indurated by long-continued suppuration of the cellular tissue and skin, underneath which are cavities filled with a mixture of pus and urine, and where the *fistulæ* wind in devious tracks.

3. *Fistulæ* which remain as unhealed tracts after the operations of lithotomy or cystotomy, reaching as far back along the urethra as the prostate; or *fistulæ* which are kept open by the lodgment of fragments of calculi or other foreign bodies escaping from the bladder. These *fistulæ* often open into the rectum instead of at the surface of the perineum.

4. The last variety comprises *fistulæ* where wide gaps have been produced by sloughing of the walls of the urethra and overlying integuments.

The course of a urinary fistula is always from bad to worse, so long as the obstruction which caused it remains; the passages become more numerous, the abscesses in their course larger and deeper, the strength of the patient is steadily sapped away, and cystitis from continuous retention of urine in the bladder adds to the patient's sufferings. Further, the kidneys undergo chronic interstitial nephritis, and in time lose much of their secreting tissue. Hence, urinary fistula, in addition to being

a cause of constant suffering and pain, is a danger to the life of the patient. In those cases where no impediment to the flow of urine exists with the fistula, as in *fistulæ* produced by sloughing, the patient's health recovers though the unnatural gap or channel remains unclosed, and he suffers only from deformity, or from the inconvenient exit through which his bladder is emptied.

Treatment.—It will be seen that of the foregoing varieties of fistula the great majority are caused by stricture; consequently, one main requirement for the cure of fistula is to open up the natural passage for the urine. In simple *fistulæ*, where there has been an abscess of limited extent and the perineum is not indurated beyond the area of the abscess, dilatation of the stricture to its normal width by the interrupted passage of bougies or by internal urethrotomy (see STRICTURE OF THE URETHRA), thereby restoring the flow of urine to the natural channel, is often sufficient to cause speedy closure and consolidation of the fistula. But care must be taken to keep open the dilated stricture by the regular passage, at short intervals, of a bougie of large size (No. 24 or 25, French scale). When, in addition to simple obstruction, abscesses or pouches filled with urine and pus have formed along the course of the urethra, or there are more than two passages from the urethra to the surface, simple dilatation or internal division of the stricture is not sufficient; a more direct escape must be provided for the contents of the suppurating cavities. External division is necessary, in order that not only the urine, but also the infiltrating contents of the passages and cavities, may be thoroughly drained away.

In such cases, perineal section is usually performed by one of the following methods. When a Syme's grooved and shouldered staff can be passed along the urethra, the incisions are most conveniently made with its guidance. When a staff cannot be passed through the stricture, the straight staff of Wheelhouse should be carried as far as the stricture, to serve as a guide for the boutonnière incision for exposing the anterior extremity of the stricture. See BOUTONNIÈRE. By this means a fine probe and grooved director can be passed through the stricture to the bladder, and the stricture itself thoroughly divided before the *fistulæ* are laid open and drained. It may happen that, even in the simplest cases, the maintenance of a free passage for the urine along the urethra does not altogether prevent the escape of a few drops into the

fistula at every act of micturition. This small quantity of urine is sufficient to keep up irritation and prevent the closure of the fistula. To overcome this difficulty, the urine must not be allowed to flow at all along the urethra. It must be withdrawn from the bladder through a catheter. If this is done, the walls and the fistula soon granulate and shrink together until thoroughly consolidated. To provide for the removal of urine by catheter, the patient must be trained to pass one himself on every occasion when it is needful to void urine.

By regulating the diet, removing all stimulants therefrom, and limiting the quantity of liquid imbibed, it is seldom necessary to pass a catheter more than thrice, or perhaps twice daily. The urine should always be withdrawn before defecation, lest straining of the levator muscles drive some drops of urine into the urethra. The catheter should not be tied in the urethra; but withdrawn after each act of micturition. Experience shows that, if a catheter is constantly in the urethra, that canal soon widens or relaxes around it, and the urine not only escapes through the catheter from the bladder, but also by the side of it, and so easily finds its way into the fistula.

Even when great care is taken to maintain a free channel for urine along the urethra, and to prevent its entry into the fistula, the latter sometimes refuse to heal. If so, they should be carefully examined for the presence of pouches or blind alleys charged with pus. If any are found, they must be opened and drained. If, on the other hand, no such cause of delay is discovered, and the fistulae are simply indolent, cicatrization may be expedited by injecting them regularly with astringent lotions, by irritating them with the galvanic cautery, or with a probe armed by fusing on its tip a globule of nitrate of silver.

For the rectal fistulae left after lithotomy, the patient should keep the prone position continuously for several weeks, so that the urine may be driven as little as possible against the floor of the bladder and prostate, through which the fistula passes. The gap may be encouraged to shrink and close, by burning its edges from time to time with the galvanic cautery, or, if a very wide gap, the edges may be pared with the knife and brought together with sutures, in a manner similar to that for closing a vesico-vaginal fistula.

The general health is often much broken down in cases of severe stricture and fistula. This must be improved by rest, tonics, and nutritious food.

The last variety—cases where large gaps in the wall of the urethra and integument have been left after sloughing action—are often difficult to treat. Those behind the scrotum usually contract and close in time, if the stricture be kept carefully dilated. Those in the penile portion need plastic operations for their cure; such are fully described under URETHROPLASTY.

BERKELEY HILL.

URINE, Morbid Conditions of the, in relation to Practical Surgery.—The importance of the urine in so-called 'surgical' cases, and the points which should be particularly noted by the practical surgeon, will be best described and understood by detailing the conditions met with in clinically examining the urine in such cases, by noting at the same time the pathological products in the same, and by stating what are the causes of their appearance.

The systematic observation of the urine, in the way described below, will not, of course, be necessary in its entirety in every case, but the main points at least must be carefully investigated (e.g. the presence of albumin, sugar, &c.) before any active surgical treatment is ever commenced.

It may be as well here to draw attention to the salient clinical points to be observed in the act of micturition itself, since these depend partly upon the condition of the urine (i.e. quantity, &c.), as well as upon that of the excretory organs; and the relation between the matter excreted and the process of excretion is so intimate that they cannot practically be separated. Following the scheme originally suggested by Sir Henry Thompson, we shall arrange the facts for this purpose under the headings of—(1) frequency; (2) difficulty; (3) pain; and simply tabulate in two columns the causes which produce the abnormal symptoms—viz. those which are directly exciting from changes in the urinary apparatus, and those which arise from the condition of the urine.

Frequency.—As a preliminary, it should be noted whether the frequency is abnormally marked by day or by night or both; since it is obvious that a simple local condition like vesical calculus will, when the patient is up and about in the daytime, give rise to great irritability, which subsides to a large extent when he is at rest at night. And this properly brings us to note that, while, of course, the fact of a patient micturating at night is, under any circumstances, to be regarded as of importance, it must not be forgotten that persons vary in their habits, and that the habit of rising

in the very early morning to micturate is not very uncommon among people in good health; and the same influence of

habit, too, determines differences in the number of times a patient micturates during the day.

1. Due to changes in Urinary Apparatus, direct or indirect.

2. Due to changes in the Urine, direct or indirect.

Frequency	Increased	A. With increased flow of urine	Polyuria { Lesion of cerebrum? Lesion of medulla oblongata (including cerebellum) Diabetes mellitus. Contracted kidney. Cystic ditto. Tubercular ditto. Albuminoid ditto. Febrile polyuria after the crisis.	
		B. Without increased flow of urine	Stricture of urethra. Prostatic disease. Cystitis. Tumour of bladder. Calculus in ditto. Tumour of kidney. Tubercle of ditto. Calculus in ditto.	
	Diminished	Without diminution of flow	Any degree of retention due to prostatic or urethral obstruction.	Decomposition. Calculus deposit.
		With diminution of flow	Fatty kidney. Final stages of albuminoid and contracted kidney.	



From the foregoing table the conditions which lead directly to an increase or decrease in the quantity of urine excreted are visible at a glance, and also the relation they bear to the process of excretion, or, in other words, their clinical symptomatology.

We will, therefore, rest contented with noting, later on, one or two facts concerning the quantity of urine excreted, and meanwhile briefly refer to the questions of difficulty and pain in the act of micturition, in so far as they depend on morbid states of the urine. For physical changes in the urinary tract, reference must be made, of course, to the special articles on the organs involved. See STRICTURE; PROSTATIC HYPERTROPHY.

Difficulty of micturition from the state of the urine may be caused by plugging of the canal by—(1) calculus; (2) blood-clot; (3) portion of new-growth; (4) excessive quantity of ropy mucus (urine alkaline, &c.).

Pain in micturition due to the state of urine may be caused by—(1) excessive acidity (especially noticeable if any part of the passages is congested); (2) passage of calculi, clots, fragments of growths, crystals (urate of ammonia), gravel.

Since the foregoing facts concerning micturition have been detailed as far as they are connected with the morbid conditions of the urine, we can now note systematically the changes which arise in the condition of the urine in disease, and especially with reference to surgical practice. The order followed is that one which is

found most useful clinically—namely, quantity; smell; reaction; colour, including blood; specific gravity; urea (see special article UREA); albumin; sugar; chyle; fat; urinary deposits and crystals. See URINARY DEPOSITS.

Quantity.—The quantity of urine excreted by a healthy person in full exercise is, clearly, very different from the amount secreted by the same person at rest in bed, and this difference is not always adequately discounted in clinical observation. In the first place, it may safely be laid down that the quantity excreted varies nearly directly with the quantity ingested, and, consequently, a person confined to bed not infrequently excretes only 25 to 30 ounces in the twenty-four hours. Further, this quantity will vary with the amount of excretion of fluid by the bowels and skin, one compensating for the other.

In the foregoing table, showing the conditions which produce increased or decreased frequency of micturition, those which influence the quantity excreted are also classified, so that reference is here directed to the list there given. It only remains to observe that, between a slightly diminished flow and complete SUPPRESSION OF URINE, a condition of inadequate excretion or oliguria may result, which usually terminates fatally from uræmic poisoning.

Smell.—The smell of urine is a valuable mode of investigating its condition, since all fermentative changes reveal themselves

at once, especially the ordinary ammoniacal destruction of the urea, &c. The normal urinous odour appears to vary in degree with the amount of nitrogenous solids in the urine; but this correlation can only be accepted as the very roughest estimate, and the more especially since it is not at present determinable what substance produces the odour. It need hardly be said that observations made on the smell of urine are of value only when the urine has just been passed or drawn off with a catheter. Artificial odours of all kinds may be produced by drugs.

Very rarely, sulphuretted hydrogen, H_2S , gives its characteristic odour to the urine. In the majority of cases it has simply been absorbed into the circulation from a foul abscess, usually connected with the bowel. It may arise, too, from the decomposition of pus in the urine.

Reaction.—The normal acid reaction of the urine, while of value in resisting the invasion of that fluid in the bladder and kidneys by putrefactive organisms (which of course require, in the large majority of cases, an alkaline pabulum), nevertheless varies greatly in degree, the person being still in apparently perfect health—thus urine may be weakly acid, neutral, or really alkaline. Diet is the main causative agency determining these differences; a nitrogenous flesh diet causing greater acidity, and vegetable food, on the other hand, producing alkalinity; but a distinctly alkaline non-decomposed urine must always be regarded suspiciously, until proved to be otherwise normal. Thus, for instance, the urine has frequently this reaction in diabetes.

In cases where the acidity of the urine aggravates symptoms—e.g., those of gonorrhoea, granular urethritis, &c.—it is easily made alkaline, and therefore non-irritating to the inflamed mucous membranes. Conversely, it is made acid by the administration of mineral acids. It may not be out of place to refer here to the former attempts to effect the prevention, if not the solution, of renal and vesical calculi by altering the reaction of the urine. Although the treatment of the various calculous deposits is now entirely directed into operative channels, it is still desirable to point out that distilled water is of great value in aiding the natural solution of acid salts in the tubules of the kidney, and that by this simple method a valuable flushing out of that organ is obtained.

Colour.—The normal colour of the urine is interesting from the very important point of view of its origin. That it is derived

from the hæmoglobin of the blood is probable, but the process of formation of the pigment (urobilin) is absolutely unknown, and reference must be made to text-books for discussion of this point. Pathologically, the colour of the urine may be altered as follows:—

1. *Diminution of Colour.*—Every degree of paleness may be found in urine in proportion to the increase in the watery constituents, the solids remaining the same. Diminution, however, of the normal pigment may occur without increase in the watery excretion. This diminution of pigment is found in connection with general failure of pigment-formation in the body—as in cases of anæmia, albuminoid disease, &c.

2. *Increase of Colour.*—The urine may be ‘high-coloured,’ as it is termed, from an increase of tissue-metabolism and excretion of solids; and, in cases where this condition has been produced by pyrexia, a red colour is seen to be added to the urine, being produced by a pigment which has been termed ‘urerythrin,’ but which is perhaps only an altered condition of normal urobilin.

3. *Additional Coloration.*—(a) The urine may be coloured from a dusky red to a dark brown from the presence of blood. See URINARY DEPOSITS; HÆMATURIA.

Further, similar colour is produced by hæmoglobin—that is to say, methæmoglobin—when that form of the blood-colouring matter is found dissolved in the urine without a trace of red blood-corpuscles. In some cases the amorphous red deposit, found in the urine, has been taken for hæmatin. And this condition, under which the colouring-matter is excreted apart from the corpuscles, has been termed hæmatinuria; but spectroscopic examination shows that, in the large majority of cases, the substance is methæmoglobin, and the condition, therefore, should be known as hæmoglobinuria. It is scarcely necessary here to do more than point out the great importance clinically of recognising this state of things in cases of hæmaturia, and, further, that a leading characteristic is its proclivity to be paroxysmal, and that each paroxysm is evoked by cold and nerve-fatigue.

Detection of methæmoglobin is rendered easy by—(1) the fact of the colour being present in the absence of corpuscles; (2) the characteristic spectrum; thus, the urine being *perfectly fresh*, there will be seen a band in the red between C and D, together with the ordinary bands of oxy-

hæmoglobin on the green side of D, while no broad absorption from E to F is seen, such as is produced by hæmatin.

The accompanying table may be of value in estimating the clinical import of the occurrence of blood in the urine:—

Condition of the mixture of blood and urine

1. Completely mixed. (Note that the blood-discs are mostly broken up, and that blood-casts are common.)
2. Incompletely mixed (i.e. usually numerous clots). (Note that the blood-discs are mostly unaltered, and that casts are rare.—Salkowski u. Leube.)

- Acute congestion (idiopathic and reflex action of drugs).
- Pyelitis (acute septic).
- Embolism.
- Tubercular disease (usually pyelitis).
- Traumatism (*vide infra*).
- Renal calculus.
- " tumour (especially carcinoma).
- Acute specific conditions (scurvy, blackwater fever, &c.).
- Renal traumatism (laceration, gunshot wounds, &c.).
- Renal tumour (portion of growth may be entangled in clot).
- Rupture of bladder.
- Cystitis.
- Vesical calculus.
- Vesical tumour (blood usually expelled at end of act of micturition). Portion of growth may be entangled in clot.

It is, of course, to be remarked that the above table only represents the commoner conditions under which blood occurs as such in the urine, and that the distinction drawn between the degrees of mixture and the presence or absence of clots is to be regarded as liable to frequent exception. Within reasonable limits, however, the above facts will be found to hold good.

Of course, no mention is made here of bleeding from the urinary passages after micturition. See URETHRA, Diseases of the.

(b) Bile-pigments are commonly present in the urine in cases of jaundice (obstructive) as a dark brown coloration, which is due to all forms and derivations of bilirubin, and easily detected by Gmelin's test of the play of colours produced by the addition of nitric acid.

(c) Melanin. This substance, the pigment of melanotic tumours, is occasionally found in the urine of patients suffering from that form of new-growth. It is usually brought out by the action of oxygen, either by exposing to the air or by oxydising reagents, such as nitric acid.

(d) Indigo occasionally appears in the urine in excess, and is of especial interest to the practical surgeon from two points of view. In the first place, its precursor, indican, is excreted by the kidneys whenever the substance indol, which itself is the precursor of indican, one of the putrefactive results of pancreatic digestion, is absorbed (and formed) in quantity by the small intestine. The circumstance of practical interest under which this occurs is that of acute obstruction of the small intestine. Occasionally, the indigo may reveal itself by its colour when the urine is allowed to putrefy with exposure to the air, but, as a rule, it is necessary to mix the urine with an equal quantity of hydrochloric acid, and then to add a very little chloride of lime, when the well-known colour of indigo-blue

appears, and may be dissolved in chloroform. More frequently we have seen the colour to be a red purple from the formation of indigo-red, &c. There is no doubt whatever that this reaction is useful as an aid in determining whether the obstruction, in a given case, is affecting the large or small intestine.

The second point of interest is that, as discovered by Dr. Ord, it is possible for an indigo calculus to be formed, although, of course, this is very rare.

(e) The above rarer pigments have been described before reference is made to the black colour produced in urine by the action of carbolic acid, because they are mostly exaggerated amounts of derivatives normally produced by tissue-metabolism, whereas, of course, the colour produced by carbolic acid is almost always an artificial effect. Although phenol compounds have similarly been found to occur in the urine as the result of absorption by the small intestine of some of the katalytic products of its action, still the coloration of the urine by carbolic acid usually means its employment in excessive quantity as a therapeutic agent. The well-known black brown coloration of the urine is produced by oxydation of hydrochinon, which is the form in which the phenol compounds appear in the urine. The hydrochinon is at first present as a colourless sulphate, which splits up, and the hydrochinon becomes oxydised to a brown product. A parallel substance termed brencatechin by Baumann, which also darkens on exposure to the air, is a phenol derivative belonging to the aromatic series.

Having discussed the preliminary points to be observed—viz. the quantity passed, the smell, reaction, and colour—we will now briefly consider the solids found as pathological constituents in the urine, it being remembered, of course, that many of these occur under normal conditions of

health, and that it is their exaggeration or diminution which brings them into the following category. The points to be observed are arranged in the order of their practical importance.

Specific Gravity.—The estimation of the specific gravity is of some value, when the quantity of urine excreted is known, as indicating the amount of solids present; but variations, not exactly commensurate with increase in weight of the solid constituents, occur when the specific gravity is raised by the presence of sugar, albumin, &c., an average normal being 1020.

Urea. See UREA.

Albumin.—In the very large majority of cases the albumin, which appears in the urine as the necessary result of destructive degenerative conditions attacking the glomeruli, &c., of the kidney, is serum albumin, pure or mixed with serum globulin, and as such is detected by the now classical methods of heat, acidification, picric acid, Oliver's test papers, &c., for details of which the manuals of urine-testing may be consulted. The quantitative estimation, however, deserves especial attention, as being a factor of great moment in deciding the practicability of surgical operative procedures in a patient suffering from this, the ordinary form of albuminuria. A rough estimate of the amount passed may be made by taking a sample of the whole twenty-four hours' urine, precipitating the albumin, and allowing the precipitate to settle for twenty-four hours. The latest

Albumin.

1. Serum albumin (and serum globulin).	a. Renal vascular changes	Arterial blocking (vasomotor?). Venous obstruction (pressure of tumours, &c.).
	b. Renal parenchymatous changes	Acute inflammation (simple or septic). Hyperæmia, &c., in fevers of severe and continued type. (This includes all specific diseases, zymotic and septic.) Chronic nephritis. Chronic interstitial ditto (granular contracted kidney). Albuminoid degeneration. Pregnancy.
	c. Injuries, &c., of the nervous system	These probably are indirectly through the vasomotor system for the most part, but possibly also of course by direct action on the kidney.
	d. Drugs	All violently acting substances, which increase renal secretion.
2. Hemialbumose (halfway substance between albumin and peptone). Determinable by clotting in the cold after urine has been boiled with HNO ₃ and filtered hot.	Osteomalacia (Bence Jones). Urticaria (Salkowski). Hæmoglobinuric condition (Neale).	
3. Peptone. Determinable by precipitation by tannin, phosphomolybdic acid, and by giving a red violet colour when mixed with alkaline copper sulphate solution. If albumin is already present, it is got rid of by treating the urine with acetate of soda and ferric chloride, boiling and filtering.	Occurs when general metabolism is much disturbed, as in phosphorus-poisoning and in profuse suppuration. See ALBUMINOID DEGENERATION.	

form of this method (Esbach's) consists in perfect precipitation with picric acid, and collection of the urine and precipitate in graduated tubes. The more elaborate results, obtained by weighing the dried mass obtained from the total twenty-four hours' urine, are to be relied on only where very accurate work is required, but a sufficiently good clinical result will be obtained by the above simple methods of allowing the precipitate to settle. The influence of the albuminous urine on polarised light is also made use of in estimating the amount of albumin more or less accurately. Before alluding to the practical importance, in clinical surgery, of correctly estimating the occurrence and degree of albuminuria, it will be better to tabulate the kinds of albumin known with certainty to be excreted pathologically, and at the same time to note the conditions of such excretion. The fact, however, that albumin in the form of egg albumin, or albumen, when taken in excess by way of diet will appear as such in the urine (having escaped digestion by reason of its quantity), is first to be thought of in seeking for a cause in any given case of albuminuria; and further, it is to be remembered that, in a certain proportion of people who are apparently in fair health, albuminuria may appear in an intermittent or paroxysmal form, the exciting causes of which are very obscure.

The following list gives the various kinds of albumin producing the condition of albuminuria:—

Causation of Abnormal Excretion.

The clinical importance of albuminuria, in its relation to practical surgery, will be seen from the foregoing table to narrow

itself to two distinct issues. In the first place, the condition indicates general depression of metabolism both primary and

secondary, and therefore, if general operative measures are in any way contemplated, their performance should depend entirely on the amount of albumin daily excreted on the one hand, and the urgency of the operation on the other. Further, a prognosis as to the chance of the wound healing, the recovery from shock, &c., must also be determined simply by the degree to which the albuminuria extends, compared with the general physical condition of the patient. In expressing these very general conclusions, it is to be understood that the kidneys are supposed diseased in any of the above-mentioned ways, except that by albuminoid degeneration. In this last condition several cases have from time to time been recorded with indubitable accuracy, where there was albuminuria coupled with the other signs of the disease, and yet where recovery has followed even such an operation for complete removal of the diseased part as amputation through the hip-joint. The second point is much more important—namely, the question how far it is advisable to operate upon the urinary tract, where there is coexistent albuminuria. Under the heading URETHRAL FEVER will be found described that condition of the nervous system which is excited by operations on the urethra; the reflex congestion of the kidneys which follows such interference, in a

large proportion of such cases, must of course demand special attention when the kidneys are already so degenerated as to admit of the excretion of albumin. As a rule, the precautions described in the article referred to will prevent an untoward result if the albuminuria is slight, such as not infrequently accompanies severe strictures. As most operative measures on the urinary tract, however, are surgical necessities, the fact of coexistent albuminuria will not usually weigh much with the surgeon in deciding what to do, but it should count very heavily in the formation of a prognosis. Indeed, for such a prognosis, the degree of albuminuria must, other things being equal, be regarded as the factor of first importance. *See* ALBUMINURIA.

Sugar.—Of the utmost importance to the practical surgeon is the occurrence of glycosuria, for not only has he then to do with a disturbance of the proper storage and metabolism of the carbohydrates in the body, but, also, has to take into account the great derangement of the general metabolic processes which follows as a secondary result of the circulation of sugar as such, and which is revealed by the clinical observations of emaciation and the often greatly increased excretion of urea. The causes of glycosuria, where the sugar is dextrose, may be tabulated as follows:—

Action of—

- | | |
|----------------------------------|--|
| 1. General causes | { Pregnancy.
Suckling.
Over-feeding. |
| 2. Lesions of the nervous system | { Injuries of the medulla oblongata and base of the brain and cervical spinal cord.
Hæmorrhage into parts of the cerebrum.
Concussion, with laceration of the brain.
Meningitis.
Tumours of the base of the brain. |
| 3. Specific diseases | { Malaria, cholera, diseases of the liver, diseases of the heart and lungs which produce congestion of the liver—e.g. chronic lung-diseases and tricuspid incompetency. |
| 4. Drugs | { Chloral, chloroform, ether, alcohol, amyl nitrite, morphia, curare, &c. |

The detection and estimation of the sugar, by means of Fehling's solution, is too well-known to need repetition here. We, therefore, shall pass on to glance at the general effect on the system which is produced by glycosuria, and which necessitates great alteration in the surgical treatment of disease. In the first place, as just remarked with reference to albuminuria, and hinted at in explaining the increase of urea excreted in this disease, the general degeneration of the tissues will render it of course highly advisable not to perform any operation, unless absolutely or urgently necessary, upon a diabetic patient. It is this degeneration of

the connective tissues, of the skin, &c., which easily leads to suppuration, boils, &c., commonly attacking these patients. The transitory glycosuria which occasionally attacks members of a glycosuric family, and senile glycosuria also, must be distinguished from the ordinary fatal disease, diabetes, in forming any such conclusions as that above indicated. Very rarely, sugar of muscle, inosite, has been found in the urine.

Chyle.—In chyluria the urine contains a white albuminous fluid, which forms a sort of sediment, partly composed of small cells, &c. In chyluria the coexistence of albumin and fat is of importance, as sug-

gesting at once the true nature of this condition; but it is impossible to confound it with that seen (rarely) after fractures of bones (so-called Lipuria, *vide infra*), the milky emulsion showing that the fluid in the urine is chyle, and not the mechanical mixture of oil and urine about to be described. How the lymphatics come to discharge their contents into the urinary passages is unknown; but both in India and in England (in persons who have been abroad), the *filaria sanguinis hominis* worm has been detected in the blood, apparently possessing a causal relation to the condition. In many cases, however, this factor is apparently wanting, and its pathology remains obscure. Chyluric patients are, by reason of the direct interference with the absorption-power of the lymphatic system, specially bad subjects for surgical treatment. *See CHYLURIA.*

Fat, or excretion of fat, will readily occur under mechanical conditions which liberate it from its normal position, such liberation being effected by traumatic means. This is not the place to describe in detail the pathology of fat-embolism; but in very severe crushing fractures, where a quantity of bony cancellous tissue, medulla, &c., is injured, as e.g., at the lower end of the femur, fat is occasionally absorbed (of course as oil), and has produced embolism in the lungs, &c. That it should be excreted by the kidneys is not surprising, and more than one author has detected the fat on the surface of the urine. This, however, is not the experience of English observers, and it is yet doubtful how far the kidneys can excrete the fat in such cases. *See FAT EMBOLISM.*

The causes of fat (as such) being present in the urine are—

1. Traumatism of bones.
2. Phosphorus-poisoning.

Very rarely cholesterin has been found in the urine (Salkowski).

VICTOR HORSLEY.

URINE, Retention of. *See RETENTION OF URINE.*

URTICARIA (*Synon.* Cnidosi; Nettle-rash).—An acute or chronic disease of the skin, characterised by the appearance of wheals on any part of the cutaneous surface, including the scalp, and occasionally on the mucous membrane of the mouth and throat. Wheals, which are pathognomonic of urticaria, are due to acute circumscribed oedema of the skin, and vary much in size and appearance. They may be no bigger than a split pea, or as large as

an egg or more, and sometimes, when closely placed or confluent, may occupy a large tract of the skin (urticaria conferta). Their colour varies with the amount of hyperæmia by which they are accompanied; they are vivid pink, or of a paler red tint, which is not uncommonly limited to the margin of the wheal, the central part being of a bright whitish-grey (U. porcellanea); sometimes the whole wheal is white, and is seated on faintly erythematous, but otherwise normal, skin. They are circumscribed, and project above the surface to a varying extent, being nearly always flattened; but in some cases they are accompanied by oedema of the subcutaneous areolar tissue, and are then not only of large size, but very prominent (U. tuberosa; giant urticaria). When they are situated on parts in which the skin is loose (eyelids, prepuce, scrotum), they give rise to much diffused swelling. In shape they are rounded or oval as a rule, giving rise by confluence to the most various gyrate and map-like figures, but often form prominent streaks, straight or irregular in course. Sometimes, the amount of serum poured out in a wheal is so great as to raise the epidermis in a bleb (U. bullosa), or congestion is so extreme that rupture of capillaries may occur, blood being poured out into the skin (U. hæmorrhagica; purpura urticans). The one character which is common to them all is their evanescence; they appear suddenly, and after lasting a short time (a few hours at most), disappear completely with equal suddenness, leaving absolutely no trace of their existence, the skin on which they were seated returning to a perfectly normal condition, except when vesication or hæmorrhage has occurred.

Wheals are due to a great variety of causes, but in order that these should be efficient there must be a specially irritable skin, or idiosyncrasy, in the affected persons; for, of many subjected to the same conditions, by no means all get urticaria. When this irritability is extreme, simple friction by rough clothing, as flannel, is enough to produce wheals, and they can always be evoked by rubbing with a blunt instrument or scratching (U. factitia). Contact with aniline dyes, exposure to cold, and electrical stimulation, will also produce wheals on specially sensitive skins. All diseases of the skin in which there is much itching are very liable to give rise to urticaria, as scabies, phthiriasis, eczema, prurigo; further, the more direct irritation of the bites and stings of insects, fleas, bugs, gnats, &c., and contact with nettles, may

give rise to more or less extensive outbreaks of wheals. Indirect causes of urticaria are very numerous; the more important are—(a) irritation of some part of the mucous membrane of the digestive, urogenital, and perhaps respiratory tracts; thus, outbreaks have been observed to follow dentition, the passage of gall-stones, puncture of hydatid cysts of the liver, intestinal worms, the application of leeches to the os uteri, menstrual irregularities, miscarriage and asthma. (b) Certain diseased conditions have been noticed to be frequently accompanied by urticaria; for instance, jaundice, diabetes, Bright's disease, ague, rheumatism and typhoid fever. (c) Various articles of food are among the most frequent causes: chiefly shell-fish—as crabs, lobsters, and mussels; eggs, mushrooms and cucumbers; raw fruit—especially strawberries and currants—and various other substances, in specially susceptible persons. (d) Many drugs have occasionally given rise to urticaria: as copaiba, cubebs, turpentine and essential oils, capsicum, santonin, chloral, morphia, and salicylic acid. The three last-mentioned groups probably give rise to urticaria owing to the circulation of abnormal materials in the blood. (e) Lastly, urticaria may have a purely neurotic origin; it has been noticed to alternate with or replace neuralgia; and mental excitement, the passions of anger, fright, and grief are sometimes the starting-point of severe outbreaks.

Urticaria is doubtless to be looked upon as an angio-neurosis, an irritation of the terminations of sensory nerves in the skin and mucous membranes being followed by reflex spasm of the arterioles in the affected part, and this, again, by paresis, leading to congestion and serous effusion. Accordingly, the microscopic appearances of a wheal are mainly cedematous swelling of the rete Malpighii and of the corium, with a slight accumulation of leucocytes in the latter around the blood-vessels, which are dilated and full of blood at the margins of the wheal, the central parts being anæmic owing to pressure of the effusion; the lymphatic vessels of the part are also dilated and full of corpuscles.

Urticaria consists essentially in the appearance of wheals, which have been already fully described; but the following varieties may be noticed, as their symptoms differ to some extent.

1. ACUTE URTICARIA.—This form is often accompanied by a rise of temperature, preceded by languor, chilliness, &c.; sometimes the fever is very high (*U. febrilis*), and there

may be delirium. The patient is much distressed by sensations of burning, tingling, or itching, which are soon followed by a copious outbreak of wheals, generally affecting a large part of the cutaneous surface, and accompanied by much erythema; when the face is affected much disfigurement results from general cedema. In this severest form of urticaria, which is fortunately rare, the mucous membrane of the mouth, fauces, and pharynx is often implicated; the tongue, uvula, and soft palate become much swollen, and swallowing is rendered difficult. Dyspnoea often is present, especially when the larynx is involved; notwithstanding the severity of the general symptoms, the fever is sometimes very slight. The onset is very sudden, and, happily, subsidence also, a few hours to a few days bringing the attack to an end. The commonest cause of this variety appears to be a severe mental shock; but errors in diet, of the kinds already enumerated, not infrequently give rise to a severe general urticaria (*U. ab ingestis*), which runs a very rapid course, and may be at an end in a few hours (*U. evanida*).

2. CHRONIC URTICARIA.—An acute attack, however, not uncommonly passes into a milder condition, without fever, in which wheals continue to appear from time to time on various parts of the body, and this state, with remissions, may continue for weeks, months, or years. The remissions, though usually distinct, are sometimes so slightly marked that there is a practically continuous production of wheals; which, however, retain their distinguishing characters of abrupt appearance and subsidence and short duration (*U. perstans*; *urticatio*). This condition is the cause of much suffering to the patient, and may give rise to anæmia and weakness, sleep especially being much interfered with. It has, on rare occasions, been followed by blotchy pigmentation of the skin.

3. URTICARIA PAPULOSA (*Lichen urticatus*).—This variety is confined to children, and usually occurs in those who are out of health and weakly, but is now and then met with in the robust. It is characterised by the appearance, chiefly at night, of pale red wheals, varying in size from a finger-nail to an almond, scattered over the trunk and extremities, most plentifully on the former. The wheals subside, but leave behind them small pale hemp-seed-sized papules, which are more permanent, lasting several days; these are due to effusion of lymph, and are undoubtedly produced by scratching, as they are found excoriated or

with minute adherent blood-crusts, are intermixed with scratch-marks, and differ in no particular from the precisely similar papules which are met with in scabies, phthiriasis, and prurigo. The disease is very obstinate, and resists treatment, especially when it cannot be associated with digestive derangement, dirt, and bad hygienic conditions.

4. *URTICARIA PIGMENTOSA*.—This name is given to an extremely rare affection, of which about twenty cases have been described. They all occurred in children, the age of onset varying from a few days to six months; the general health was usually good; the duration of the disease always very long, lasting for years. The lesions met with are of two kinds: (a) flat, pigmented, more or less erythematous patches of varying size, not raised, scattered over the whole surface except the palms and soles, most numerous and largest on the trunk; the erythematous patches are constantly the seat of fugitive wheals. (b) Raised, pigmented nodules, which are permanent; the distribution is the same. The pigmentation in both varies from buff to light brown, and the wheals, although met with in both, are most characteristic of the first form. The permanent pigmented nodules, although they may occupy the site of wheals, are no longer to be included in this category; they last for many years, and are richly infiltrated with cells.

Diagnosis.—The diagnosis of urticaria need give rise to no difficulty, if it be remembered that wheals are the essential mark of the disease, and that these, however various in aspect, size, and distribution, are invariably characterised by abrupt appearance and subsidence, and by evanescence; further, that itching, stinging, and tingling are prominent symptoms in urticaria, and are absent, or only slight, in other affections to which it bears a superficial resemblance. When the face is attacked, and especially if there be high fever, the oedema of the eyelids and general swelling may be so considerable as to produce a close likeness to erysipelas; the rapid evanescence, the large cutaneous area simultaneously affected, the absence of spreading at the margin, and subsidence without branny desquamation, will be sufficient to distinguish it. The red rash which accompanies acute urticaria may be mistaken for scarlatina; but its occurrence on the face, its more sudden onset, the intense itching, and the absence of the characteristic throat and tongue of scarlatina, are sufficient distinctions, even without the charac-

teristic wheals. Some gyrate and annular wheals are like the lesions of certain varieties of erythema multiforme; but in the latter we have a characteristic localisation, a darker red colour, a greater permanence, and much less itching. The large swellings of erythema nodosum are not unlike the wheals of urticaria tuberosa; but here also localisation, permanence, absence of itching, and especially the characteristic bruise-tints during subsidence, will easily clear up the case. The bullous form of urticaria is not likely to be confounded with pemphigus, if it be borne in mind that in the latter the bullæ appear in successive crops, and are mostly seated on skin which is in all respects normal. Only a careless observer can take the chronic, unchanging, pigmented maculæ and nodules of urticaria pigmentosa, unassociated as they are with any other lesion—except wheals, for infantile syphilis.

Treatment.—The treatment of urticaria resolves itself into discovery of the cause, and its removal when possible; when this cannot be done, the results of medication are often very unsatisfactory, although great improvement may be nearly always obtained and the distress relieved by palliative measures. When the wheals are due to scabies and pediculi, these parasites must be destroyed by the usual methods; the irritation caused by the bites of fleas, bugs, and gnats should be met by removal of the cause when possible, and by the application of a lotion containing bicarbonate of soda, or of sal volatile. If eczema be present, that must be cured first, and, when it is at an end, the urticaria will probably not require much further treatment. The other sources of external irritation, rough flannel in contact with the skin, stuffs coloured with aniline dyes, or even badly-fitting undergarments, which are likely to cause friction especially at the root of the neck, across the shoulders, and around the waist, should be carefully looked for, and rectified when found. The dress of urticarial patients should be neither too light nor too heavy, since both heat and cold are likely to be injurious; for this reason they should avoid crowded hot places, as theatres, and sleep in a cool room, with light bedclothes.

If no external cause can be discovered, we must inquire into the condition of the internal organs, more especially the alimentary canal, and it is here that the irritation which is reflected upon the skin will be very frequently met with; if it be found that any of the articles of food already specified have been recently taken, or that any drug has been administered likely to

cause an outbreak of wheals, these should, of course, at once be stopped. The attack itself is best treated, if seen early, by a quick emetic, such as sulphate of zinc or mustard, and a brisk purge, more especially if the mucous membrane of the mouth and throat be affected; if there is much fever, an antimonial saline will be beneficial, or the administration of alkalis and diuretics, together with fluid food, may be sufficient. When there has been much antecedent dyspepsia, this should be treated carefully, and the diet must be regulated; of course all the articles likely to cause urticaria must be forbidden, and, in addition, coffee, pungent condiments, and stimulants should be excluded; but it is necessary to study the idiosyncrasy of each patient with regard to food, as perfectly harmless substances, such as milk or eggs, will often cause urticaria in the specially predisposed. When tænia or other intestinal worms are present, they must be treated by appropriate means. Locally, lotions may be employed to allay the itching, the best being one of carbolic acid (1 to 40 or 60) or chloral (gr. x. ad f3j.); alkaline and starch baths are also useful. If the urticaria occurs in association with menstrual irregularities in anæmic and hysterical women, iron is especially indicated, and arsenic is occasionally of value in small doses; but these cases are often obstinate and difficult to treat. When the affection appears in the course of acute disease, as rheumatism and typhoid fever, it requires no special treatment beyond a little soothing lotion, and will subside of itself when the illness which it complicates is at an end.

The same rule applies to cases occurring in association with chronic disorders, as Bright's disease and diabetes; but here, as the irritation is due to the circulation in the blood of abnormal materials which are a necessary concomitant of an incurable condition, it is obvious that amelioration only can be looked for, the urticaria improving *pari passu* with the general health. An acute urticaria due to mental shock will subside of itself, and requires no special treatment beyond a day or two's rest in bed; possibly, a saline purge may be required. Where a purely neurotic urticaria is of intermittent type, quinine, especially combined with hydrobromic acid, and arsenic are indicated; in other chronic neurotic cases much difficulty will be encountered, and the drugs recommended are so numerous that it is plain that all are often unsatisfactory. The following may be tried: Salicylate of soda, tincture of cannabis indica, tincture of bella-

donna, and bromide of potassium; atropin by the mouth, in doses of 1 to 2 milligrammes (about grain $\frac{1}{100}$ to $\frac{1}{80}$) per diem, has lately been much praised; it is also necessary in these cases that all dietetic and hygienic precautions should be taken, and good results have been stated to follow change of air and scene.

In the treatment of urticaria papulosa, hygienic measures are of the first importance; without cleanliness, pure air, good food, and suitable clothing, but little progress can be made. When these conditions are favourable, treatment should be directed to improving the digestion, which is nearly always faulty, the urine being often loaded with urates, and the stools deficient in bile or otherwise abnormal; a mixture containing bicarbonate of soda in some aromatic water, with or without bismuth, to which bromide of potassium may be added, and occasional doses of grey powder or rhubarb and soda will be found beneficial; while anæmia and debility are best treated by cod-liver oil and iron. If intestinal worms are present, treatment should be directed to their removal. Locally, weak alkaline baths, followed by inunction with oil or vaseline, may be recommended, and, in very chronic cases, an ounce of potassa sulphurata may be added to the bath; if the itching is extreme, a lotion of carbolic acid or some other antipruritic may be used. It should be remembered that the affection is very obstinate, and liable to relapse under any treatment.

JOHN CAVAFY.

UTERINE APPENDAGES, Removal of the.—The position of the patient, of the tables, and of the instruments, spray-producer, &c., are exactly the same as for OVARIOCTOMY, and need not be again described. The opening in the macintosh sheet which covers the abdomen should be long and narrow: long, because if it be found advisable to remove the tumour a long incision will be necessary; and narrow, to expose as little of the abdominal parietes as possible, so as to avoid chill during the operation. In addition to the instruments required for ovariectomy, a couple of Kœberle's serre-nœuds which have been for some days in carbolic oil (1 to 20), several wires of different lengths and sizes, a pair of special forceps for tightening and cutting the wire, and a strong nickel-plated corkscrew should be at hand. The Nélaton forceps and the vulsellum will not be wanted, and need not be placed in the trays.

An incision three inches long should first be made, so that the hand can be introduced

and the position of the ovaries and tubes and their relation to the tumour ascertained. If the size and nature of the tumour be such as to afford a good prospect of cure from the removal of the appendages, and the relations of the latter to the tumour such that they can be cleanly and safely removed, they should be dealt with just as in OVARIOTOMY and OÖPHORECTOMY; but special care must be taken not to puncture any vessels in transfixing, because it is much more difficult always, and often quite impossible, to apply a fresh ligature on the proximal side of the puncture to stop hæmorrhage from it. Both sides should be securely ligatured, and any sponging of the peritoneum completed before the appendages are cut away, and it is advisable to leave the stumps a little longer than in oöphorectomy.

Supra-vaginal Hysterectomy.—If hysterectomy be decided upon, the incision should be prolonged to the left of the navel, so as to allow the uterus, with tumour and appendages, to be brought out without undue bruising of the edges of the incision. The raising of the mass is often very difficult, especially if it be wedged or adherent in the pelvis; the extraction will be made much more readily if a strong broad-bladed corkscrew be screwed into the fibro-myoma, to serve as a handle to lift it out of the abdominal cavity. Abdominal adhesions should be separated and secured as far as possible before the extraction, and it is much more often advisable to divide them between two forceps or two ligatures than in ovariectomy, the solid tumour allowing hæmorrhage more readily than the collapsed cyst-wall.

As soon as the tumour is extracted, its base must be carefully examined to see whether the appendages can be included in the wire; in some cases it will be better to transfix the broad ligaments and tie them off separately, applying the wire round the uterus where the broad ligaments are cut on each side, or even transfixing the ligaments on each side with the wire. The relation of the bladder to the uterus in front must also be carefully defined before the wire is tightened, and it will often be necessary to make a transverse incision just above its vesical fundus and peel it back, so as to allow the wire to be properly applied. When the wire has been made to encircle the base of the mass in the desired place, generally just above the internal os, it is drawn up as tightly as possible by means of a special pair of forceps, and twisted twice round the knob of the screw of the *serre-nœud*, and then twice round the

stem; the wire is then slowly and carefully screwed up. Haste or undue force may break the wire or cut the uterus, and cause serious hæmorrhage. The wire loop must, of course, be firm, but it is better not to screw it up too forcibly at first, as it can be tightened little by little afterwards as the tissues shrink and when the uterus and tumour have been cut away. When the wire has been screwed up, a long strong pin, with a little looped handle at one end to hold it by, should be pushed through the whole mass just on the distal side of the wire, and its point protected by a little cap which screws on over it. Sponges are then packed round the base of the tumour, and it is rapidly cut away; it is well to leave a large stump at first, as it can be trimmed down after the wire is finally screwed up and the other steps of the operation completed. If the ovaries and tubes are included in the wire (not tied off separately), care should be taken in putting the pin through to make it thoroughly transfix the broad ligament on both sides as well as the uterine stump, and it is advisable also to run a needle, threaded with a strong silk, round the cut peritoneal edge of the broad ligament on each side and into the fibrous tissue of the stump, and thus tie the cut broad ligaments, bag-mouth fashion, tightly to the edges of the stump. Adhesions having been all secured, the peritoneum should now be sponged out, especial care being taken to cleanse the pouch in front, which is practically shut off from the general cavity, when the operation is completed.

The stump is then held up in the lower angle of the abdominal incision and a strong silk suture is passed through the peritoneum and parietes just above it, and at once tied so as to hold it in position. This suture should not be too tight, or it may cause suppuration by tension, but it should be tight enough to keep the peritoneum and other tissues closely applied all round the stump. It is better not to place any suture below the stump. The remaining sutures are now introduced and the wound closed. Drainage by the glass tube is to be especially avoided in this operation, because the mouth of the tube comes out close to the uterine stump, in the centre of which is the opened uterine cavity—a certain source of sepsis; and if the tube is once put in, and requires to be kept in beyond the first two or three days, putrefaction will be almost certain to invade it from the stump. When the abdominal cavity is closed, the stump should be pared down as closely as it safely can be; it is

better to cut out its central solid part, and leave its peritoneal edges rather longer. When it has been sufficiently pared, it is carefully packed round with small pieces of dry carbolic gauze, which should also be placed under the pin and serre-nœud to prevent them from cutting into the skin, as there is frequently considerable pressure upon them in the course of the first week after operation. The raw surface of the stump should be carefully treated with solid perchloride of iron: this dries it, and prevents it from decomposing. Of course, care must be taken not to put on so much iron that it can, before the peritoneum has sealed, trickle beside the stump into that cavity; but the surgeon who allows this must be a very clumsy manipulator.

In ordinary cases, especially when adhesions are absent and the appendages can be included in the wire of the serre-nœud, the operation of supra-vaginal hysterectomy is an extremely simple one, and far easier than a difficult ovariectomy, or than any operation for the removal of the uterine appendages; but in cases with many adhesions, or in which there is a broad base requiring enucleation from the broad ligament before the wire can be applied, it may be an exceedingly difficult one. The hæmorrhage from adhesions and during enucleation is often very profuse, and may try the nerve of the bravest surgeon. In dressing the wound after operation, the upper part of the incision should be dressed with a separate dressing, and then the lower straps and the dressing over and round the stump can be changed as often as is necessary, while the main part of the incision can be left undisturbed, as in ovariectomy, till it is time to remove the sutures. If the stump be carefully treated with perchloride of iron at the time of operation, the first dressing may be left on two days, then changed under the spray, the screw tightened, the stump clipped and redressed with iron, and this may be repeated every second day, until very little of the stump remains to separate or cut off when the serre-nœud and pin are removed. Sometimes, the wire cuts through in a couple of weeks, and the serre-nœud, pin, and stump are found loose under the dressing, but more often it is necessary to cut through the wire and remove it about that time, and clip away the dead stump. Care is required, in doing this, to avoid cutting into living tissue, or very severe hæmorrhage or serious septic absorption may result. Even when cutting in the slough, the mucous membrane lining the remains of the uterine

cavity will often be still living, and bleed so as to require the application of a little fresh iron.

After the removal of the serre-nœud, &c., or its natural separation, the stump sinks deeply and forms a cone-shaped depression which heals slowly by granulation. If the drag on the stump has been great, it may tear the tissues which have adhered round it as it sinks, and some hæmorrhage may occur, or still more dangerous septic absorption; and whenever this seems probable, it is well to touch the granulation-tissue all round with the perchloride of iron: this at once checks any oozing and seals the small vessels. Various other methods of treating the stump have been tried, but none is so sound, both in theory and practice, as the use of the perchloride when it is properly applied.

Wire clamps and serre-nœuds of various kinds have also been invented, and the old ovariectomy clamp has still its advocates; but the Kœberle serre-nœud is infinitely easier of application, simpler, cleaner, and more efficient than any of them.

The method above described is called the extra-peritoneal, in contradistinction to the various methods of ligature of the stump with suture of flaps, and dropping it into the peritoneum. The fatal objection to all the intra-peritoneal methods is, that in the opened uterine cavity of the stump there is a putrefactive centre, and, however it is treated, it is impossible to be quite sure that it is rendered aseptic or thoroughly shut off from contaminating the newly-cut surfaces. The most dangerous of these methods is undoubtedly the imitation of the practice in ovariectomy—i.e. transfixion, ligature, and simple dropping of the stump. In this method the putrefactive centre is left in the middle of half-strangled uterine tissue, actually open in the peritoneum; and the terrible mortality of the procedure makes it quite unjustifiable.

Schröder has proposed and practised, with considerable success, the following method: the appendages are ligatured off, and a strong elastic ligature is temporarily placed round the uterus instead of the wire; the tumour is cut away, and a V-shaped piece is cut out of the centre of the stump; the cavity is cleaned or cauterised with strong carbolic acid solution (1 to 10); the mucous edges of the cut cavity are sutured together at the bottom of the V, and the sutures cut short; successive rows of sutures are then applied, cut short, and covered in by the succeeding rows until the peritoneal edges are reached and sutured. The elastic ligature is then

removed and the stump dropped in. The objection to this method is, of course, less than to the simple ligature mentioned above, but the cleansing of the uterine cavity must be imperfect and uncertain, and the sutures in the cut edges of the uterine cavity are very liable to absorb putrid material, and become so many centres of septic infection. The enclosing of successive rows of short sutures in dense tissues, without provision for escape of effused products, is also objectionable. In cases in which it is impossible to bring the stump outside with the wire and pin, this is doubtless the next best method.

In some cases, it may be necessary or advisable to employ both methods, bringing the central stump out with the *serre-nœud*, and closing large cavities in the broad ligament, left by enucleation of the base of the tumour, with sutures. It is, however, still an open question whether it is not better to secure all bleeding points and allow the edges of the cavities simply to fall together, so as to avoid collections of fluid in closed spaces, the serum running into and being rapidly absorbed by the peritoneum if it is allowed free access to that cavity.

Another extra-peritoneal method, which has succeeded well in Germany, is the replacing of the *serre-nœud* by the elastic ligature, the stump still being pinned outside and treated with chloride of zinc.

If it be absolutely necessary to use the glass drainage-tube in any of these operations, its mouth should be shut off as much as possible from the stump and wound by being made to project through a pure rubber sheet, which grasps its collar tightly and is filled with carbolised sponges, to take up the discharge as it overflows from the tube.

Whether a cure be brought about by removal of the uterine appendages, or by some method of hysterectomy, it is clear, from recent results, that a new and successful era has dawned in the surgical treatment of uterine tumours.

J. KNOWSLEY THORNTON.

UTERINE TUMOURS.—Fibro-myomata, fibro-cystomata, polypi, sarcomata, and the various forms of carcinoma, are all of great importance, as their presence necessitates some of the most formidable operations which the surgeon is called upon to perform. They vary so greatly in their causes, symptoms, diagnosis, and treatment, that general remarks upon them are of little value, and each is therefore discussed separately.

FIBRO-MYOMATA, as their name indicates, are composed of fibrous tissue and unstriped

muscle-cells, the relative proportions of these tissues varying much in different growths.

Cause.—There is but little, if any, definite knowledge of the causes which excite the growth of these tumours; probably, they owe their origin to prolonged congestion and inflammation of the uterine walls, and anything which produces these pathological states may start their formation. Irregularities of menstruation, displacements of the uterus, and mechanical injuries, are exciting causes. Single and married women are both liable to them, but married women are their more frequent hosts. Married women, who are childless, more often have large tumours than those who have borne children; but this may be in part, at any rate, due to the fact that the involution of the uterus, which follows childbirth, frequently causes the absorption and disappearance of these growths. Small fibro-myomata, which would have grown large in single or sterile women thus disappear, probably in many cases without their presence ever having been detected. Their presence may also cause sterility.

Pathology.—The appearance on section, and the density of a fibro-myoma, vary according to the relative proportion of fibrous and muscular tissue which it contains: when the former predominates it is glistening, white, and hard, cutting like cartilage; when there is a preponderance of the muscular element it is soft and red-looking (fleshy). The substance of the growth is but sparingly supplied with blood-vessels, but large vessels ramify over its capsule, from which it appears to derive much of its nutrition. There is usually one point at which its tissues are directly continuous with those of the uterine wall, and here such blood-vessels as it possesses enter; hence, the broader this base the greater the vascularity of the growth, and, as a rule, also, the more pronounced its muscular element. Generally, there is a distinct capsule of areolar tissue, but sometimes the growth seems merely to occupy a hollow space among the proper tissues of the uterus. Lymphatic spaces are sometimes found between the bundles of fibrous and muscular tissue, and nerves have been traced into the substance of the tumours.

There are three chief varieties named according to their relation to the proper uterine tissues—subperitoneal, interstitial or mural, and submucous. The first and last may be either pediculate or sessile. The subperitoneal are the slowest in growth and usually the least dangerous, as they do not,

as a rule, enlarge the uterine cavity, and do not give rise to hæmorrhage; they are apt, however, to cause ascites from mechanical irritation of the peritoneum, and, from the same cause, form adhesions to surrounding organs. The interstitial and submucous both enlarge and deform the uterine cavity; the former are often a cause of much pain, and the latter of serious hæmorrhage. All varieties are liable to degenerative changes—cystic, calcareous, and suppurative—and the submucous are apt to cause necrosis of the mucous membrane, and then slough themselves. The interstitial variety often cause very considerable hypertrophy of the whole uterus, and thus produce hæmorrhage of a different kind from that due to the submucous. All much more commonly affect the body of the uterus than the cervix, and the almost pure myoma is commonly situated in the fundus.

Symptoms and Diagnosis.—The chief symptoms which indicate their presence are disordered menstruation, especially menorrhagia and metrorrhagia, pelvic pain, and a sense of fulness and bearing down, vesical and rectal troubles, nerve pains in the lower extremities, and œdema of feet, legs, or vulva. Some one or all of these symptoms may be present while the growths are comparatively small, and may disappear with the later symptom of abdominal enlargement, just as like symptoms disappear when the pregnant uterus rises out of the pelvis. In a large number of cases they produce no symptoms at all, and sometimes they attain an enormous growth without the patient knowing that there is anything wrong.

The diagnosis of their presence must be made chiefly by their physical examination by the vagina, by the rectum, and externally, and by a combination of these methods; the symptoms to which they give rise being also useful as corroborative of the more definite physical signs. The latter are their consistence, their continuity with the uterus, and their relations to neighbouring organs which are found to be healthy. The differential diagnosis has already been given, to some extent, under OVARIAN TUMOURS, as they have to be differentiated from the same morbid conditions there described. In the majority of cases, anyone with fair experience and careful examination will find no great difficulty; but, when they are small and confined to the pelvic cavity, it is sometimes quite impossible to be absolutely certain. The uterine sound, denoting the length of the cavity, is useful for the interstitial and submucous varieties, but is of

little use for the subperitoneal, as the cavity is with them often normal, and moving them in the abdomen does not affect the sound *in utero* more than the same moving of an ovarian tumour with a short pedicle. The sound should always be used with extreme care or it may give rise to very dangerous hæmorrhage, or, by perforating a thinned mucous membrane, cause sloughing of the growth and septicæmia.

Treatment.—If it be thought advisable to remove a subperitoneal fibro-myoma which has a pedicle, the operation is exactly the same as OVARIOTOMY. The extraction of the large solid growth will probably require a longer incision, and may be facilitated by screwing a strong corkscrew into the growth, and using this as a handle to lift it out of the peritoneum. The pedicle should be firmly tied by a No. 4 silk ligature, and the ends of the ligature should then be threaded into a strong straight needle, and passed through the pedicle on the distal side of the first tie, and then again firmly tied round each half of the pedicle. By this method any oozing from the transfixion puncture is avoided.

If the pedicle be very thick, it may be prepared for the silk ligature by having an elastic ligature first applied, or the wire of a *serre-nœud* firmly screwed up, and then the silk is tied in the groove thus formed, the elastic ligature or wire having been first removed.

If the pedicle be too thick to admit of this treatment, a temporary elastic ligature should be applied round the body of the uterus, the tumour cut away, and two flaps formed out of its pedicle or its base in the uterine wall. These flaps should then be brought together by a succession of rows of fine silk sutures, the first row being applied at the bottom of the angle between them; the flaps are cut short and covered in by a second row applied in the middle of the flaps, and these again are covered in by a third row applied to the peritoneal edges (Schroeder's method). In cutting the flaps, care should be taken not to cut so deeply as to open the uterine cavity.

Submucous fibro-myomata which bulge much into the uterine cavity, especially if the mucous membrane over them has necrosed, may be removed by enucleation. The cervix is dilated by Hegar's dilators, the capsule of the tumour is incised, and the growth is enucleated by the operator's fingers, which may be aided in some cases by Thomas's spoon-saw. If the base be very broad, it may be necessary to divide it

with the *écraseur*. Bleeding points may be touched with perchloride of iron, or compressed with long pressure-forceps, and the cavity stuffed with plugs of iron cotton. A very efficient method of checking oozing, and at the same time securing asepticity, is to plug the cavity with a sponge squeezed out of tincture of iodine. If this be used, it must be long enough to project through the cervix, or it may be drawn within the cavity, when the cervical canal will close and its extraction will be a matter of much difficulty. If it be left projecting well into the vagina, the uterus will expel it in the course of twenty-four hours, or it can be easily drawn out. In all cases, full doses of ergot should be given for the first few days after enucleation, and the vagina must be frequently syringed out with some antiseptic solution.

If the submucous tumour has a very broad base, and is deeply bedded in the uterine wall, it is better to treat it in the same way as the intramural variety—i.e. by the removal of the uterine appendages.

If an intramural fibro-myoma, a submucous fibro-myoma, or a general thickening of the uterine wall be thought to necessitate operation, the removal of the uterine appendages is the operation to be recommended. *See* UTERINE APPENDAGES, Removal of the.

In advising this operation, however, it is necessary to explain to the patient that, though it will probably cure, the process is a gradual one, and, also, that after the abdomen is opened the relation of the ovaries and tubes to the tumour, or the adhesions they have formed, may be such as to render the operation impossible, or to make it more difficult and dangerous than the complete supra-vaginal ablation of the organ (supra-vaginal hysterectomy). In ordinary cases, the operation of removal of the appendages is a much less dangerous one than a complete supra-vaginal hysterectomy, but it should always be left to the discretion of the surgeon which operation he will employ, when he has opened the abdominal cavity and thoroughly examined the tumour.

FIBRO-CYSTOMATA.—These are rare, and usually arise from softening of a fibro-myoma, the fluid being contained in spaces between the bundles of fibrous or muscular tissue, and large cavities being formed by the absorption of the intervening trabeculae. In another form the fluid gathers in lymph spaces, and the cavities are lined with endothelium.

The symptoms are identical with those which arise from the presence of the solid

growths, except that the fibro-cysts expand very rapidly. If an old fibro-myoma begin to enlarge quickly, it may generally be inferred that it is becoming cystic.

The diagnosis, except in this last form, is very difficult, as fibro-cystoma closely simulates ovarian tumour. The uterine sound may in some cases aid in the formation of a correct opinion. It is not a matter of much moment, as their rapid growth renders it necessary to remove them whenever possible. The operation for their removal corresponds with that for the removal of fibro-myomata, except that they may be reduced by tapping before extraction. Sometimes they are pediculate, and sometimes they may be enucleated, but more often it is necessary to perform complete supravaginal hysterectomy.

POLYPI.—Submucous fibro-myomata, which are in process of spontaneous enucleation, may become polypoid (fibrous polypus). They are often very large, distending the uterine cavity or the vagina, or even protruding from the vulva. They are rounded or pyriform in shape, and usually have a smooth covering derived from the mucous membrane of the uterus. The base may be broad and thick, or so long and narrow that the growth is entirely extruded, only its stalk remaining in the cavity of the uterus. As they are not very vascular, the base or stalk rarely contains any large vessels.

Mucous polypi are rarely of large size, and are more often developed from the endometrium than from the cervical mucous membrane. Their structure corresponds with that of the mucous membrane from which they spring, and they are extremely vascular. Pediculate Nabothian follicles and placental polypi are also occasionally met with, and their names sufficiently indicate their origin.

The submucous polypi may degenerate into sarcoma or be sarcomatous from the first, and are then apt to recur after removal. The mucous polypi are also liable to both sarcomatous and carcinomatous degeneration.

Symptoms.—Sometimes polypi give rise to no symptoms, or simply to some sense of irritation and discomfort, or they cause leucorrhœa or dysmenorrhœa, but their most serious and common symptom is uterine hæmorrhage; this may merely show itself as menorrhagia, or metrorrhagia, or there may be a constant bloody discharge.

Sterility may be caused by their presence, or, if pregnancy occur, they may greatly impede delivery.

Diagnosis.—When they are still contained in the cavity of the uterus, it may be impossible to differentiate them from other conditions causing like symptoms, and the cervix must be dilated for their discovery. When they protrude through the external os, they are readily recognised either by touch or sight. An inverted uterus may be mistaken for a fibrous polypus, but a careful examination of the relations of the mass at its neck, and the passage of the sound into the uterine cavity, should render the differential diagnosis easy.

Treatment.—When dilatation is necessary, the polypus should be removed at the same sitting, and it may be either twisted off, cut off with scissors, or with the *écraseur*, according to the size and vascularity of its neck. The mucous polypi may usually be twisted off, but if large should be tied, as they are very vascular. After removal of the growth, the uterine cavity and cervical canal should be cleansed with tincture of iodine, and it may be necessary to adopt some kind of plugging, as described after the enucleation of a submucous fibro-myoma. If the polypus be so large as to block the vagina and distend the vulva, it may be necessary to cut it up with the chain *écraseur*, and remove it bit by bit in order to obtain access to its pedicle.

There are various methods of dilating the cervical canal. It may be dilated slowly by sponge, or tangle, or tupelo tents, or it may be dilated at one sitting by graduated bougies or dilators, the patient being in the lithotomy position and anaesthetised. The latter is far the safest and most satisfactory method, and is much pleasanter for the patient. Hegar's dilators are the best, and full dilatation may generally be obtained in about an hour. The uterine cavity should always be sponged out after their use, first with dry cotton on a Playfair's probe, and then with cotton that has been dipped into tincture of iodine. The vagina should be frequently syringed with some antiseptic solution till all discharge ceases.

Some operators prefer the Sims position, but the lithotomy position is much more convenient for the operator, and it dispenses with the need for the use of a speculum.

SARCOMA.—Sarcoma of the uterus is met with in two forms—the diffuse and the circumscribed, and differs from carcinoma in that it more often affects the body than the cervix.

The diffuse form arises from the sub-epithelial connective tissue, and grows in rounded nodules which project into the cavity, causing softening and disintegration

of the mucous membrane, which is liable to carcinomatous degeneration; and this causes a complication which is very likely to mask the original disease. The circumscribed form occurs more often in the uterine wall, and differs from fibro-myoma, as it has no capsule.

By some these uterine sarcomata are believed only to occur as degenerations of pre-existing fibro-myomata, but this is very unlikely, as there is no reason why sarcoma should not grow from the cellular tissue of the uterus as well as from that in other situations. The round-cell sarcoma is the most common form, but other varieties are occasionally met with. The only cure for sarcoma is, as for carcinoma, the complete extirpation of the uterus.

Myxoma is also found, and may be a degeneration of the connective-tissue elements of a fibro-myoma, or be mixed with the ordinary sarcoma, as in other situations. The myxoma is of special interest to the surgeon, because this form of tumour is not amenable to treatment by the removal of the appendages, but may be dealt with by supravaginal hysterectomy if it is entirely confined to the body of the uterus, and the same treatment may cure the circumscribed sarcoma if the operation be performed early enough.

CARCINOMA.—There are three varieties of this disease which are generally recognised as affecting the uterus—encephaloid, scirrhus, and epithelioma. The two first are really the same disease, but the encephaloid is softer and more rapid in its progress from the predominance of the cellular elements; while the scirrhus form is harder and slower in its progress, the fibrous element being more marked than the cellular. Epithelioma also occurs in two forms, one flat and the other papillary; the former occurs chiefly in the cervical canal and in the interior of the uterus, and the latter more often at the os, projecting into the vagina as the well-known cauliflower excrescence. All varieties of the disease attack the cervix much more often than the body of the uterus.

Causes.—Heredity is a predisposing cause in from seven to ten per cent. of all cases. Age is also a predisposing cause, the vast majority of cases occurring between thirty-five and seventy-five, the mean between these extremes being the most common period for its occurrence. Anything which greatly depresses the vital powers also appears to predispose to the disease.

Married women who have borne many children or who have had many miscar-

riages are especially liable to uterine cancer, particularly if the births or miscarriages have followed one another very quickly. It is commoner among the poor than among the rich. Erosions and lacerations of the cervix and chronic uterine catarrh also favour the production of this disease.

Pathology.—There is wide difference of opinion as to the pathology of uterine cancer. Virchow and his followers, among whom Ruge and Veit must be specially mentioned, believe that it has its origin in the connective tissue; while Thiersch, Waldeyer, and others believe that it grows from the epithelium, and they are again divided in opinion as to the exact layer of epithelium from which it springs.

Symptoms.—These, of course, vary according to the stage, situation, and variety of the disease. In the early stages, hæmorrhage, and pain in the back, pelvis, and down the thighs are the prominent symptoms. Later, when ulceration has commenced, watery discharge, wasting and general debility, disturbance of the digestive organs, yellowness of the skin, and special pains according to the organs which are implicated, notably of the bladder and rectum.

In the still more advanced cases, dribbling of urine, escape of feces from the vagina, hydronephrosis from obstruction to the ureters, or jaundice from secondary deposits in the liver, herald the fatal termination. Peritonitis, sudden and severe hæmorrhage, or thrombosis are among the rarer accompaniments of advanced disease.

Exhaustion, uræmia, septicæmia, peritonitis, hæmorrhage, and thrombosis are the common causes of death, the two first accounting for the larger share of the mortality.

Diagnosis.—In the early stages the diagnosis is often extremely difficult, especially in the rare cases of cancer of the body.

The early stages of cervical cancer will have to be diagnosed from mere inflammatory induration with erosion, from syphilitic ulceration, from simple hypertrophy of the cervix, from lupus, from sloughing polypi or fibro-miomata, from retained portions of placenta or membranes, and from sarcoma. If the disease be in the body, it may be necessary to dilate the cervix and scrape out a small portion for microscopical examination, and, if in a more accessible situation, microscopic investigation will alone give a certain diagnosis.

Careful examination of the pelvic tissues surrounding the uterus, made both by the vagina and rectum, is also important.

Treatment.—This is either palliative or radical; the former belongs rather to the physician, but may be briefly referred to.

The local application of iron or of other styptics and astringents will be useful for checking hæmorrhage, also cold applied to the vulva and cold water injections, ergot and gallic acid internally; plugging the vagina may be necessary, or the use of strong caustics or of the actual cautery. Offensive discharge must be treated by frequent antiseptic injections. Pain must be relieved by the hypodermic injection of morphia, by atropine and morphia combined, by chloral, and by sedative pessaries. Iodoform is reputed to be useful both for relieving pain and as an antiseptic. Chloride of zinc is valuable both as a caustic and as a disinfectant.

J. KNOWSLEY THORNTON.

UTERUS, Extirpation of the.—*Abdominal Operation* (Freund's).—The usual incision having been made through the parietes and the peritoneum opened, the intestines are drawn out of the pelvis, the broad ligaments are transfixed on each side by three ligatures which are made to interlock when tied; the first loop passes through the ovarian ligament and edge of the peritoneal covering of the Fallopian tube and secures the ovarian vessels, the second loop passes through the round ligament and secures the *pampiniform plexus*. When the first two loops have been tied on each side, the ovaries and tubes are cut away, and the uterus is firmly drawn up out of the pelvis by a ligature passed through the fundus, or by a special forceps, and a transverse incision is made through the peritoneum between the uterus and bladder; the latter is then peeled back, and the incision carried through into the vagina. The uterus is then held forwards, and the peritoneum divided transversely behind to the same extent as in front, and the vagina opened into through the pouch of Douglas. The uterus is now merely held by small portions of tissue on each side, which contain the uterine arteries, and the third loop of the broad ligament ligatures is passed through on each side into the vagina, or from the vagina by a special grooved needle, and tied round the tissues containing the uterine arteries; these small bridges of tissue on each side are then cut through and the uterus removed. If the vagina is large enough to allow the separated uterus to be drawn through it, it is better to remove it by that outlet than through the abdominal incision, as there is less chance of fouling the wounded tissues

and peritoneum with the cancerous discharge.

The various steps of the operation will be facilitated by inserting an india-rubber bag, with a tube to it, into the rectum, blowing it up and tying the tube; this raises the uterus and appendages out of the pelvis, and may enable the operator to dispense with the use of the transfixing ligature or forceps to draw up the uterus. Both these are to be avoided if possible, as the punctures they make may allow putrid fluid to ooze through on to the peritoneal surfaces, whilst manipulating the organ during the various steps of the operation.

When the uterus has been removed, any bleeding points, not already secured by the transfixing ligatures, are tied with fine carbolised silk ligatures with their ends cut short; a large T-shaped rubber drainage-tube is then placed in the deep parts of the wound with its central limb protruding through the vagina, and the edges of the peritoneal wounds are brought together by points of interrupted suture, so as to shut out the tube and deeper raw surfaces from the peritoneum; the abdominal incision is then closed in the usual way. In his later operations Freund has abandoned the peritoneal suture, and leaves the ligatures which transfix the broad ligaments uncut, and hanging out in the vagina. It is, of course, advisable to thoroughly cleanse the vagina, before the operation, with a strong antiseptic irrigation, and the cervical canal may be packed with cotton or sponge soaked in a strong antiseptic such as tincture of iodine. These are necessary precautions, but they cannot be depended upon for preventing the access of septic material to the wounded surfaces, sponges, or peritoneum during the progress of the operation, and the use of the spray and full Listerian precautions are therefore not of the same importance as in other abdominal sections, in which fresh and pure surfaces only are dealt with.

Various modifications have been suggested in the method of applying the ligatures, but they are unimportant, and space will not allow their discussion. In some cases the vessels may be ligatured as they are divided, and if there is a flaccid abdomen and roomy pelvis, this modification may be found possible, and has the great advantage of avoiding the ligature of masses of tissue along with the vessels.

VAGINAL OPERATION (Schröder's).—The vagina and uterus having been thoroughly cleansed with strong antiseptic solution, and the patient placed in the lithotomy

position in a good light, the operator seats himself in front of the perineum with his back to the window. Seizing the cervix with a strong vulsellum, which he hands to an assistant to hold, he cuts through the vaginal mucous membrane all round the cervix, giving the disease as wide a berth as possible. The pouch of Douglas is then opened, and two fingers, passed in and over the fundus uteri to the front, enable the opening into the vagina to be safely made between the uterus and bladder; the fundus is then retroflected and forced into the vagina through the opening in the pouch of Douglas. The broad ligaments are now transfixed and ligatured on each side, and the uterus is drawn down, separated from them, and removed. Any bleeding points are separately tied and a T-shaped drainage-tube introduced; the broad ligament pedicles are secured in the angles of the wound by a point or two of suture on each side, or the wound may be left altogether open, the drainage-tube being merely packed round with antiseptic cotton or gauze. One great objection to this operation is that the ovaries and tubes are usually left behind, because if they are removed there is not room to securely ligature the broad ligaments, and secondary hæmorrhage may ensue. The leaving of the ovaries is not a matter of much consequence, but the tubes are structures in direct continuity with the uterus and its lining membrane, and leaving them is a fundamental breach of the law which governs all operations for the removal of malignant disease. Structures in continuity with the diseased parts, or, in other words, the entire organ diseased, should always be removed, or operative procedures are not justifiable. The great danger, in both the abdominal and vaginal operations, is the risk of including the ureters in the ligatures which secure the uterine arteries. That this is a real danger the autopsies of fatal cases abundantly prove. Septicæmia is another great danger, and in dealing with necrosed cancerous tissues it is often impossible to avoid infection of the wounded surfaces; hence, free drainage is an essential in these operations, and antiseptic irrigations should also be employed.

The vaginal operation is decidedly the simplest and least fatal, but a serious objection to it has been pointed out above, and, at present, the ultimate cures are so few that the results of the operation cannot be pronounced encouraging. Time alone can decide whether complete extirpation of the uterus for cancer is destined to establish for itself a permanent place in surgery, or

is to sink into oblivion again, as it has already done in the past, after a very decided attempt to establish it, though not on such a careful and scientific basis as in the present revival of the operation.

PARTIAL OPERATIONS.—The above operations are, of course, the only procedures possible when cancer invades the body of the uterus, but in the commoner forms of epithelioma which attack the os and cervix, partial operations will often give much relief and decidedly prolong life, while at the same time making it, while it lasts, tolerable both to the patient and to her friends.

The cautery, caustics, the *écraseur*, the scissors, and the knife each have their advocates.

The method introduced by the late Marion Sims is on the whole the best. The diseased parts are freely cut away with the scissors, then the raw surface is curetted till healthy tissue is reached, and the cavity left is packed with iron cotton (subsulphate of iron one part to two of water) and the vagina plugged with antiseptic wool. Iodoform gauze is also an excellent material. In forty-eight hours the plugs and iron are removed, and the cavity carefully packed with cotton wrung, almost dry, out of a solution of equal parts of chloride of zinc and water. The vagina and surrounding tissues are protected by being smeared with equal parts of vaseline and bicarbonate of soda, and the vagina packed with plugs of wool wet with a solution of the latter drug. After the removal of these plugs, which may be safely left in position for four or five days, as the chloride of zinc is a powerful antiseptic, the vagina is frequently syringed with an antiseptic solution. In due time a thick white slough of the wall of the cavity separates, either gradually or in a large cast; the raw surface is then carefully examined, and, if any suspicious points are seen, they are again packed with the chloride of zinc cotton. Then, from time to time during cicatrization, the surfaces are carefully examined, and if necessary a further application is made. In ordinary cases but little risk attends this procedure, and very satisfactory results are often obtained. Care must be taken, however, not to leave the iron cotton too long, or septicæmia may result, as mixtures of blood and iron seem to have a special tendency to rapid putrefaction when wet. A good substitute for the iron solution is the ordinary 1-20 carbolic lotion, saturated with pulverised alum. Hæmorrhage is rarely troublesome, but it may be necessary to use forceps or the actual cautery to some of the

bleeding points, before packing in the iron cotton. If the disease be very extensive, and the cutting and scraping carried far into the cavity of the uterus, care must be taken in packing with the chloride of zinc, or the thin shell of uterine tissue may be perforated and fatal peritonitis result. In cases in which much of the uterus has to be cut or scraped away and the operation is prolonged, very alarming collapse sometimes comes on.

Schröder has introduced two other partial operations, which are worthy of notice, and are applicable according to the extent to which the disease has penetrated the cervical tissues.

Amputation of the vaginal portion is performed by dividing the cervix deeply with scissors on each side, so as to form an anterior and posterior lip, then removing a wedge-shaped portion from each of these artificial lips, and uniting the flaps with sutures. The lateral incisions are also sutured. Supra-vaginal amputation of the cervix is performed by drawing the cervix down with a vulsellum, dividing the vaginal mucous membrane round the base of the anterior lip into the cellular tissue, and peeling back the bladder, which carries with it the ureters; then carrying the cervix forward, and incising the mucous membrane of the posterior fornix till the ends of the incision meet those made in the anterior fornix; then clearing the sides of the cervix. This is more difficult, as the cellular tissue is dense, and larger vessels are apt to be divided and should be ligatured. The cervix is cut out by the knife in a wedge shape, and the anterior cervical wall is sutured to the anterior vaginal wall, and the posterior cervical wall to the posterior vaginal wall. The lateral wounds are closed with sutures deeply placed, so as to control hæmorrhage.

In some cases, the pouch of Douglas is opened and a portion of it may have to be excised with the cervix. Schröder had thirty-three immediate recoveries out of thirty-seven operations, so that the operation is not so dangerous as it would appear likely to be. J. KNOWSLEY THORNTON.

UVULA, Diseases of the.—The uvula in its normal state consists of a thin mucous membrane superficially, a subjacent layer of racemose glands, and the fasciculi of the 'azygos uvulæ' muscles in the centre. Its physiological variations with regard to form and size are considerable, and it may be congenitally deficient, or may present a median fissure in consequence of a failure

in the union of its component halves during the process of development.

As a dependency of the velum palati it is liable to all the affections of that structure (*see* PALATE), and morbid conditions, extending from adjacent parts, may induce a special train of symptoms referable to the uvular lesion, or may become almost entirely confined to the appendage. It may also become involved in more general or remote diseases, sharing in the manifestations of anæmia, hyperæmia, and anasarca; deflected to one or other side in facial palsy, or hanging powerless in bulbar and some other paralytic complaints.

The diseases of the uvula which require a separate consideration are atonic relaxation, chronic inflammation ('hypertrophy'), and certain neoplasms.

Atonic relaxation of the uvula depends upon partial or complete loss of power in the azygos uvulæ, a condition favoured by muscular debility, and usually excited by excessive use of the voice, as in singers, public speakers, &c.

The affection, when unassociated with inflammation, often escapes recognition, since the organ may present no alteration of appearance beyond an increase in length. It will, however, be found that, during contraction of the muscles of the velum in phonation, it hangs almost or quite motionless; while the patient observes that his voice has lost both strength and quality. In some cases, nausea and paroxysms of coughing may be induced by contact of the flaccid appendage with the pharynx or glottis.

In the treatment of this disorder, repose of the affected parts, the local use of astringents, and the internal administration of tonics may be sufficient to effect a cure; but, should these measures fail, the superfluous length of the organ must be cut off. This operation may be effected (after the parts have been rendered anæsthetic by cocaine, if necessary), with a pair of ordinary blunt-pointed scissors, while the extremity of the uvula is held with forceps; or use may be made of specially constructed 'uvula scissors,' which seize the part to be removed at the moment of cutting. It entails no bad after-results, and, although some trouble has arisen from hæmorrhage in exceptional instances, the loss of blood is usually limited to a few drops. Should it be necessary, the bleeding may be checked by the application of a piece of lint steeped in a strong solution of perchloride of iron.

Chronic inflammation or '*hypertrophy*' of the uvula is an occasional result of repeated catarrhal affections of the parts.

The uvula undergoes a persistent enlargement, assuming in some cases the size of a thumb, and reaching down to the orifice of the glottis. The mucous surface is usually red and dry, and the muscular movements are impaired or lost. Histological examination has shown that the morbid changes are principally located in the submucous tissue, which becomes enormously thickened by inflammatory proliferation, and the papillary layer of the mucous membrane is slightly increased in depth. The muscular and glandular elements are little altered.

The effects are very variable. In some cases, the enlargement may attain considerable proportions without entailing any inconvenience, but in others a distressing train of symptoms may follow: a sense of discomfort in the throat, as from the presence of a foreign body; severe attacks of coughing, especially on rising in the morning and lying down at night, and on exposure to cold or after exertion of the vocal organs; and the voice may become harsh or hoarse and more or less enfeebled. The cough is usually of a peculiar character—remarkably metallic and barking, paroxysmal, difficult to check when the fit is established, and liable to terminate in sickness, but there is little or no expectoration unless the condition be complicated with laryngeal or bronchial catarrh. Occasionally, the contact of the swollen appendage with the back of the pharynx may induce frequent hawking and retching, or even vomiting; and, where the extremity of the uvula extends as far as the glottis, violent suffocative paroxysms may be superadded.

In this state the patient may continue for months or even years, alarming himself and his friends by an incessant cough, the noisy character of which is popularly supposed to be of dire portent; incapable of exercising his vocal functions without distress; and consuming numberless bottles of useless expectorants; until the real nature of the complaint is detected and proper measures employed, when the symptoms are ended by an apparently magical cure.

The treatment is that of simple relaxation—rest to the voice, local astringents, tonics, and, should they fail, amputation of the appendage. The morbid dilatation of the vessels may give rise to some little bleeding when the redundancy is cut off, but this will yield readily under the application of styptics.

Neoplasms.—The only tumours that have been found localised to the uvula are small papillomata and polypi, both of which may be removed by the scissors.

WILLIAM ANDERSON.

V

VACCINATION is the inoculation of the virus of cowpox. Cowpox is a vesicular disease of the cow, the vesicles appearing on the udder and teats of milch cows, and more frequently on young animals than on those which are older. Observers describe the incubation-period of the so-called natural disease to be usually of three or four days' duration, while that which is known to be transmitted by inoculation by milkers is believed to be two or three days longer. Apart from this difference, the subsequent local manifestations are identical: a papule forms which develops, and, at the end of three or four days more, becomes vesicular and umbilicated. During each subsequent day the vesicle increases in size, and, on the tenth or eleventh day or earlier, an areola forms which gradually extends, while the contents of the vesicle become cloudy and purulent and the vesicle loses its umbilication. From this time a crust forms over the surface, the vesicle becoming dried up and disappearing, the crust remaining for five or six days before it is finally shed.

The apparent difference in the incubation-period, between the natural and inoculated cowpox, is probably due to the fact that the moment at which inoculation takes place could not be ascertained, and if this explanation be accepted, the probability becomes greater that the disease is communicated by inoculation alone; later, under the heading *Animal Vaccination*, it will be seen that the incubation-period of inoculated cowpox is much shorter than the period stated. There is said also to be frequently variation in the length of time occupied by the various changes, and that, on the same animal, the eruption is often found to consist of papules and vesicles in different stages of development; this is probably the result of inoculation from some of the earlier vesicles, or of fresh inoculation from the original source of infection. Space does not permit a description of other vesicular diseases of the cow, but it will suffice to say that these affections are often mistaken for cowpox, and have thus led to some confusion.

There is much difference of opinion as to the origin of cowpox. Jenner, in the first instance, believed that it resulted from the inoculation of a vesicular disease of the

horse known as 'grease.' Subsequently, it was found that this affection was altogether distinct from cowpox, but that the horse was also liable to suffer from horsepox just as the cow was liable to suffer from cowpox. In the horse, however, the vesicles occur most frequently on the hocks, and are not limited to animals of the female sex. It has also been observed that cowpox has appeared among herds of cows who had not been exposed, either directly or through their milkers, to infection from horses. Finally, experiment has shown that the cow can be inoculated with horsepox and the horse with cowpox, rendering both these animals insusceptible to any effect from further inoculation by horsepox, cowpox, or smallpox. Horsepox and cowpox may, therefore, be regarded as identical, and the only point remaining for discussion is the relation of this affection to human variola.

Attempts to inoculate the cow with variolous matter have produced very different results in the hands of different experimenters. Briefly, it may be stated that in the hands of many experimenters the inoculation has altogether failed; in the hands of others a papule has been developed, the contents of which, when introduced into the skin of the human subject, have given rise to smallpox, sometimes, indeed, after the virus has been transmitted through several animals before it has been used for the inoculation of man; while a few others have succeeded in producing well-defined vesicles in the cow, the virus of which produces, when inoculated into the human subject, the usual manifestations of vaccinia. It must be borne in mind that the failure of the greater number of investigators does not invalidate the results obtained by others. Both Badcock and Ceely in England, and Thiele in Kasan, succeeded in growing definite vesicles in heifers by the inoculation of smallpox virus, and the lymph taken from these vesicles has been transmitted from child to child, producing no other results than those which follow the use of lymph taken from the vesicles of cowpox. More recently, Voigt, in Hamburg, has published successful results obtained by him in the inoculation of heifers with smallpox virus. His method has been to inoculate the animal

in the first instance with variolous matter and, immediately afterwards in another part of the body, to inoculate the same animal with cowpox. The growth of the vaccine vesicle has been accompanied by the appearance of other vesicles at the site of inoculation with smallpox virus, and the lymph taken therefrom has since been transmitted through other animals and largely used for the vaccination of human beings.

The question of the relation between cowpox and smallpox may be found in the future to have an important bearing upon the protection which is afforded by vaccination against smallpox, and it will be well, therefore, to consider very briefly the reasons which exist for regarding the two diseases as identical.

In the first instance, it may be noted that spontaneous cowpox occurs only in the female animal, and is limited to the udder and teats, man, as a rule, coming only into intimate contact with the cow and with these parts of the body during milking. Again, it is deserving of note that the horsepox appears in the horse on the part of the body which comes in most intimate contact with the hands of man, and is not limited to the female, as in the cow. Moreover, it is somewhat remarkable that spontaneous cowpox has become much less frequent in England since smallpox in rural districts has become a rare event. The simultaneous disappearance of these two affections, from country districts, points strongly to the probability that man, in some way or other, was concerned in the production of disease in the cow. Whether he merely acted as a means of conveyance of the disease from one animal to another, or whether, by becoming himself the subject of inoculation, he communicated the affection, or whether while suffering from smallpox he originated the disease in the cow, is not obvious, but that he played some part in its production there can be but little doubt. The disappearance of spontaneous cowpox from England may be explained by the fact that his condition is now altered by his vaccination in infancy, which renders him less susceptible both to subsequent cowpox and smallpox, and therefore less able to act in this capacity.

The chief argument against the identity of the virus of cowpox with that of smallpox, is the extreme difficulty with which the cow can be inoculated with the latter. In reference to this point, some importance may perhaps attach to the fact that efforts to inoculate smallpox virus have hitherto been almost limited to the use of virus

taken from the general eruption of smallpox. In an unvaccinated community, the occasional inoculation of the hands of attendants on cases of smallpox must more frequently have taken place than at the present time, when vaccination is general. It may be that greater success would attend the inoculation of heifers with virus taken from the inoculated or mother vesicle of inoculated variola, the limited number of experiments at Lyons in 1865 (*Mémoires et Comptes-Rendus de la Société des Sciences Médicales de Lyon*, tome v.) not sufficiently negating this possibility.

This question is not of mere theoretical value. If there is any foundation for the opinion, which is held by some, that the humanised lymph now generally used is less protective against smallpox than in the time of Jenner, the remedy is not necessarily to be found in the use of calf-lymph which has been transmitted through numbers of animals, but more probably in the use of lymph which has been obtained by the recent inoculation of the calf with smallpox virus. There is, indeed, no substantial foundation for the belief that the vaccine virus more naturally has its home in the bovine than in the human animal. So far a lesson is taught by the ease with which the virus can be cultivated in the one, and in the other an opposite conclusion is indicated, and, if this conclusion be well founded, the resort to calf-lymph, unless the latter be recently developed from small-pox virus, is the adoption of the shadow without the substance.

Pathology.—The experiments of Chauveau and Burdon Sanderson have proved that the virus of cowpox is particulate, and that the clear liquid which can be separated from this matter by filtration is inoperative. Microscopical examination shows that the lymph contains micrococci which may be single, in dumb-bells, or in chains. As yet these micrococci have not, after successive cultivation in nutrient fluids, been successfully inoculated into man, and this final proof is therefore wanting.

When vaccine lymph is applied to an abraded and absorbent surface in a human subject who has never suffered from variola, and who has not before been vaccinated, a growth of cells, both in number and size, accompanied by the production of intercellular fluid, takes place in the middle layer of the rete Malpighii, eventually forming cavities which are bounded by cells driven together by the fluid. At the same time the swollen cells burst, adding to the fluid in the cavities. The earlier part of this pro-

cess produces the papule, the later part producing the vesicle which is subsequently developed. The next change is the formation of a slight areola around the vesicle. The superficial areola is accompanied by an inflammation of the true skin, and the stratum lucidum becomes separated from the rete Malpighii, which in turn has developed in it a new stratum lucidum, any cellular matter above it being included in the space between the new and the old. The substance thus formed constitutes the scab, which also includes the cells lining the hair-follicles and sweat-ducts, and extending to a greater depth. The separation of the scab next takes place, the shedding of that part which is derived from the hair-follicles and sweat-glands giving rise to the foveation which is found in a normally constituted cicatrix.

Excessive inflammation will frequently lead to the destruction of the true skin, and, under these circumstances, the foveation is necessarily absent, or the new stratum lucidum may be imperfectly formed, when exudation will continue to occur from the part which is deficient. Thus the appearance of the cicatrix may be accepted as indicating the behaviour of the vesicle, in so far as it shows not only the size of the vesicle, but the fact whether it has run a normal course.

The constitutional changes that take place are very remarkable, inasmuch as they render the individual, at any rate for some time to come, insusceptible to further inoculation. These changes are not brought about directly by the introduction of the virus into the blood, but are dependent upon the growth of the vesicle in the skin. Dr. Robert Cory has shown this by a well-devised series of experiments. Dr. Cory found that it was possible to successfully vaccinate the same child every day until the ninth day was reached, after which further inoculation became impossible. Vesicles, produced by inoculation on the later days, overtook in their development those produced by inoculation on the earlier days, so that all arrived at maturity at the same time. Thus, it was found that the subsequent course of any one vesicle was entirely dependent upon the stage of development of the first vesicle, at the time of the subsequent inoculation. A further experiment consisted of the vaccination of children having supernumerary fingers upon those fingers, and of their subsequent amputation before the vesicle had arrived at maturity. When these children were again vaccinated, a month after the amputation,

it was found that the vesicles resulting ran a course which was identical with the course they would have had, if the second inoculation had taken place on the day on which the supernumerary finger was amputated, and if the amputation had not taken place: proving that the amount of protection was directly influenced by the stage of development of the first vesicle, and was arrested by its removal.

Symptoms.—The local appearances have already been indicated under the heading of *pathology*. In more detail, they consist of the formation of a papular elevation on the second or third day after inoculation, often attended by local irritation; the papule gradually increases in size, and on the fifth or sixth day becomes vesicular. The vesicle develops until the eighth day, when it has a bright pearly appearance, a depressed centre, and in the latter part of that day or the beginning of the next commences to be surrounded by an areola.

The areola increases until the tenth day, when it is usually about two inches in width, measuring from the vesicle; the vesicle then becomes cloudy, dark in the centre, and begins to scab, the areola at the same time fading. The scab usually falls about the twenty-first to the twenty-fifth day from the time of inoculation, leaving a depressed sore having a definite outline, and its surface covered with a number of minute depressions, forming the foveation which is characteristic of the vaccination scar. The general symptoms are, as a rule, but very trifling: there is often a slight increase of temperature of the body in the latter half of the first week and lasting until the seventh or eighth day, when the temperature falls, a further rise taking place about the ninth day and lasting but a few hours; in some cases there is a distinct feeling of indisposition, especially about the ninth or tenth day.

From this course there may be several departures, due to conditions peculiar to the lymph and to conditions peculiar to the child.

The vesicle may be retarded in its development, not arriving at maturity until twenty-four or forty-eight hours after the eighth day, but, apart from this, going through the usual course. Cases are also said to have occurred in which no result followed the inoculation for some weeks, but after this period vesicles eventually were formed; such cases must, however, be exceedingly rare. Other cases occasionally occur where the inoculation has apparently produced no results, but, after further

vaccination on the eighth day, vesicles appear at the site of the first inoculation. The formation of the areola is occasionally postponed or prevented by the child being under the influence of mercurial treatment. The formation of an early areola, and the more rapid development of the various stages, will result when the child has an irritable or eczematous skin, or if it has been unsuccessfully vaccinated a short time before, or when care is not taken to select lymph from vesicles running a normal course, the use of such lymph being often attended also by failure to produce any result. Such lymph will sometimes cause distinctly irritant effects; eczematous children are especially susceptible to such influences, and even when lymph is used which in healthy children produces absolutely normal results. That the lymph itself sometimes contains the elements for producing irritative results, is obvious from the fact that, of a number of children vaccinated from the same vaccinifer, several may be thus affected at the same time.

The behaviour of the vesicle in such cases is as follows:—On the eighth day there is often no abnormal appearance beyond, perhaps, the existence of a somewhat larger areola than usual; but, on the tenth day, the areola becomes extensive, spreading over the arm. At the same time, supernumerary vesicles appear in the neighbourhood of the primary vesicles, and the whole number coalesce, forming a large bleb, which scabs and constitutes a thick crust, from beneath which there is an offensive discharge, leaving eventually a deep unhealthy-looking ulcer. These symptoms are almost invariably attended by the appearance, on the tenth day, of a general eruption of *vaccinia lichen*, to be hereafter described. In the latter part of the second week, fugitive patches of erythema occasionally appear on the extremities and other parts of the body, and may be mistaken for erysipelas, which they somewhat resemble. Lymph may, however, show its irritative qualities at an earlier date than this; thus, there may be on the eighth day a large areola, the vesicles at the same time being broken and discharging freely a serous fluid. Such cases can, however, only result when every regulation for the selection of proper lymph for vaccination is disregarded.

The vaccine vesicle, and especially in children with irritable skins, occasionally differs in other respects from normal vesicles: thus, the vesicle may never fully develop, but, while spreading from the edges, is flat and depressed, and has a

grey-brown appearance; it does not properly scab over, but the scab becomes detached piecemeal, leaving an unhealthy indolent sore, which is often of considerable duration before cicatrisation finally takes place, the surface later becoming sometimes covered with large granulations, which rise up above the level of the skin and exude moisture. A further irregularity may occur, at the time of separation of the normal crust, by the formation of another from the discharge of the surface beneath; under these circumstances, the second crust will remain an indefinite time and often has eventually to be removed by poulticing.

Treatment.—The normal vesicle requires no interference. The day after the inoculation has taken place, the surface may be sponged gently to remove any coagulated blood which may have collected at the site of operation. After this, it should be protected by a soft piece of clean linen, and every care taken to prevent injury from rubbing and scratching. Shields should never be worn; they constantly become displaced, and by pressure often interfere with the circulation. It is not uncommon to find them used for one case after another, and thus they become soiled with animal matter and are a very possible source of danger. Poulticing and moistening the vesicle should be avoided; this practice interferes with the natural process of scabbing, and poulticing frequently leads to the whole vesicle sloughing out, leaving a deep ulcer. In cases where the crusts have run together and a thick mass is formed, sufficient time should be given to allow this to separate; if, however, the separation is unduly delayed, and at the same time an offensive discharge escapes from beneath, the whole should be poulticed until the crust separates, and the remaining ulcer dressed with lint and zinc ointment. When the scab has either not formed properly or has separated prematurely, leaving an unhealthy-looking ulcer, zinc ointment dressing will be found to answer exceedingly well.

Eruptions.—The vaccination of infants is occasionally followed by cutaneous eruptions. Those most common are *roseola* and *vaccinia lichen*, occurring usually from the seventh to the tenth day after vaccination. The former appears in slightly raised erythematous patches over the chest, back, and extremities, but in the course of a day or two the eruption fades. *Vaccinia lichen* also appears about the same time, usually, and is often associated with the roseolous rash. It appears in the form of numerous

minute papules on the face, chest, back, and the front of the limbs; often the papules become vesicular, resembling the vesicular rash which occasionally occurs in scarlatina. In most cases the eruption lasts but two or three days, and then gradually fades; in certain exceptional cases the vesicles on the foot and face become much increased in size, and are somewhat persistent. Later erythematous blushes have been already alluded to. Eczematous rashes are also occasionally produced, usually from the seventh to the tenth day after vaccination, in eczematous children, the fissures behind the ears, which are often found in such children, at the same time increasing and discharging serous fluid.

Syphilitic children in their turn may suffer from syphilitic eruptions. VACCINATION-SYPHILIS is treated of later on, but it may be stated here that the inoculation of syphilitic virus at the time of vaccination does not immediately show itself, but usually, after the scab has formed, some ulceration takes place at the site of the cicatrix, and later the specific eruption makes its appearance. Apart from this, however, specific eruptions occasionally appear about the tenth day after the vaccination of a previously syphilitic child. In these cases there is no special appearance about the vesicle, which runs a normal course. The vaccination has simply been the occasion of the appearance of the symptoms. The writer holds that the lymph may be eliminated from suspicion, as the same event will equally occur after the use of calf-lymph. Erysipelatous eruptions may result from the inoculation of erysipelatous matter at the moment of vaccination, or later when the vesicle is opened for the collection of lymph; or it may occur at any time if the vesicle be broken and the child exposed to the infection of erysipelas, even at the time of the separation of the crust, should the subjacent tissues be not entirely healed.

These eruptions may be treated on general principles, altogether apart from any consideration of the fact that the child has been recently vaccinated.

SELECTION OF LYMPH.—Lymph, which is intended for vaccination, should be taken from vesicles not later than the eighth day after inoculation—i.e. on the day week of operation—and only from perfectly healthy infants having a good family history. The child should be carefully examined as to physiognomy, skin-eruptions, snuffles, and all other signs of syphilis, the buttocks and arms should be inspected, and any appear-

ance which gives rise to the least doubt or suspicion should be a reason for the lymph being condemned. Lymph should only be taken from the primary vaccination vesicles of infants, and never from older persons or from any child undergoing re-vaccination. The vesicle should have run a normal course and be normal in appearance, clear, pearly white, and no lymph should be taken if any one of the other vesicles is broken or is abnormal in appearance. There should be but little areola. It is commonly recommended that lymph should only be taken from vesicles absolutely without areola; but this rule has been departed from by experienced vaccinators, who do not discard a vesicle on account of a commencing areola. Indeed, the best results are often obtained when there is an areola which is of limited area, of a bright colour, and when it is accompanied by the appearance of slight papular elevations, which may occasionally be interspersed with minute vesicles on the surface surrounding the vesicle.

While the general rule must be laid down that the lymph should be perfectly clear and translucent, it must be admitted that cloudiness may exist, which does not interfere with the production of perfectly normal vesicles; lymph which flows rapidly should be distrusted, it is often of poor quality and likely to lead to failure. Too much lymph should not be collected from any one vesicle; as the lymph exudes from the vesicle after puncture, it is sometimes replaced by serum, which necessarily dilutes the virus, and it is therefore well to abide by the official recommendation: 'From such a vesicle as vaccination by puncture commonly produces, do not, under ordinary circumstances, take more lymph than will suffice for the immediate vaccination of five subjects, or for the charging of seven ivory points, or for the filling of three capillary tubes; and from larger or smaller vesicles take only in like proportion to their size. Never squeeze or drain any vesicle.'

Precautions as to Vaccines.—The best age for the vaccination of infants is before the beginning of dentition; the law, therefore, wisely requires the vaccination of children before the end of the third month, but there is no reason why it should not be performed earlier. There does not appear to be any special risk attaching to the vaccination of infants only a few days old, nor is this early period a reason for vaccinating less efficiently than at a riper age. Except in cases where there is im-

mediate risk of exposure to infection of smallpox, only healthy subjects should be vaccinated. The child should, therefore, be in good health and free from any sign of eczema, such, for instance, as fissures behind the ears. No child should be vaccinated who is exposed to contact with any of the acute infectious diseases but smallpox, and the infection of erysipelas should be especially avoided.

METHOD OF OPERATION.—A great variety of instruments have been invented for the inoculation of vaccine lymph. It is unnecessary to describe them in detail: many are constructed with a groove which is intended to hold the lymph, and to give opportunity for its better introduction at the moment of incision. It must be remembered that any such irregularity of the surface serves also to retain other matter, and to interfere with the proper cleanliness of the instrument; such apparatus should, therefore, not be used. There is no better instrument than an ordinary bleeding lancet, which is not too sharp. The sharper the blade, the greater will be the hæmorrhage resulting from its use; and excess of bleeding is not only on sentimental grounds to be avoided, but it has also a tendency to wash out the lymph. The only appliances which are necessary are the lancet, a clean napkin, and a small basin or glass of water. In the performance of the operation, the vesicle of the vaccinifer should be carefully punctured in a number of places, the greatest care being taken to avoid the drawing of blood. Should there be the least appearance of blood in the lymph which exudes, the vesicle should be abandoned, and the lancet carefully cleaned.

Assuming no such accident to happen, a globule of lymph should be taken upon the point of the lancet, the arm of the vaccinee should be firmly grasped by the left hand of the operator, the skin of the child at the site of inoculation being stretched between his fingers and thumb. The lymph may be inserted by puncture, by a series of scratches, or by both methods. At the moment of puncture the lancet should be half-turned, so that the edges of the blade open the small wound which has been made, and, during scratching, the blade should not be held at right angles to the skin, but obliquely, in order that a larger amount of absorbent surface may be produced by each scratch. The amount of surface to be covered by the scratching must necessarily depend upon the size of the vesicle it is intended to produce.

Lymph from more than one vaccinifer should never be used for the vaccination of the same child. A caution is needed as to the mode of transference of the lymph from the vaccinifer to the vaccinee. The lancet should be charged with sufficient lymph to enable the operation to be completed without the necessity of returning to the vaccinifer for more. Should, however, this necessity arise, the lancet should be dipped in the water and carefully wiped, to prevent communication to the vaccinifer of any blood or other matter from the vaccinee, where it might not only cause injury to the vaccinifer, but to other children vaccinated from him. In direct arm-to-arm vaccination, ivory or bone points should never be used for this purpose instead of the lancet. They can never be properly cleaned, but are liable to retain animal matter about them, and have indeed been a potent source of mischief.

If lymph is about to be used which is stored in capillary tubes or on ivory points, the procedure is necessarily a little different. If stored in tubes, both ends should be broken off, and the lymph blown on to the point of the lancet and immediately inserted. If stored in points charged with humanised lymph, it is sufficient to rub the point over the excoriated surface, the blood which is drawn providing enough moisture to remove the lymph from the point. In the case of points charged with calf-lymph, it is desirable to dip the charged end, which adheres more firmly to the ivory, momentarily into water, to shake off immediately the superfluous moisture, and to allow the point to remain for a few minutes before it is rubbed over the surface.

The important question of the size and number of the vesicles which must be produced has to be considered. There is too much tendency at the present time to forget the sole object of vaccination—the protection against smallpox—and to consider only the requirements of the law, which does not specify the details of size and quality of the vesicle. The duty of the practitioner is obviously to vaccinate in such a manner that the infant shall be protected, if possible, for life, and certainly until it has arrived at an age when it can decide for itself whether the protection shall be renewed. To yield to the oft-made suggestion of the mother to vaccinate the child in few places, is to be guilty of a breach of duty to the patient. The production of one small vesicle will undoubtedly render the child absolutely insusceptible to smallpox, but for a time only; the return to susceptibility occurs

more rapidly than when the vaccination is more efficient. The statistics of every small-pox hospital, which have been tabulated, tell the same story, that the severity of attack and mortality from smallpox occurring in vaccinated persons is inversely proportionate to the number and quality of the vaccination cicatrices. The official memorandum, *Instructions to Vaccinators under Contract*, recommends: 'In all ordinary cases of primary vaccination, if you vaccinate by separate punctures, make such punctures as will produce at least four separate good-sized vesicles, not less than half an inch from one another; or, if you vaccinate otherwise than by separate punctures, take care to produce local effects equal to those just mentioned.' Again, the award to public vaccinators, for vaccination of the first grade, is only given when the scars produced are well-marked in their foveation, and have

collectively at least half a square inch of total area.

It is, however, necessary to ascertain whether the same amount of protection is afforded by a vesicle producing one large cicatrix as by several which together cause a smaller cicatricial area. The data upon which an opinion can be expressed is not yet sufficient for such opinion to be very definite; but a lesson may perhaps be learnt from the behaviour of the vesicle, in revaccination of persons whose primary vaccination in infancy was of such a character as to leave one large cicatrix having a large superficial area, and comparing these results with the behaviour of the vesicle in revaccination of other persons whose primary vaccination produced three small vesicles, leaving cicatrices whose aggregate did not exceed the area of the one large cicatrix.

RESULTS OF REVACCINATION OF PERSONS AGED FROM TEN TO THIRTY YEARS.

	Cases in which the areola of the revaccination declined on the eighth day or earlier, and were therefore further removed from condition of complete susceptibility	Cases in which the areola of revaccination declined after the eighth day, and therefore more nearly approached complete susceptibility
Possessing one primary vaccination cicatrix having a diameter of five-eighths of an inch or more	11, or 48 per cent.	12, or 52 per cent.
Possessing three primary vaccination cicatrices each having a diameter of three-eighths of an inch or less	119, or 67 „	58, or 33 „
Possessing one primary vaccination cicatrix having a diameter of half an inch or more.	17, or 53 „	15, or 47 „
Possessing three primary vaccination cicatrices each having a diameter of a quarter-inch or less	49, or 75 „	16, or 25 „

It will be seen by the above, that the protection afforded by primary vaccination has lasted longer where the cicatrices are numerous and small, than where there is but one large cicatrix. The numbers on which the percentages are calculated are undoubtedly small, but there is, nevertheless, sufficient uniformity in the result to warrant the belief that one large vesicle will protect less than three smaller vesicles, although the aggregate cicatrices of these may be smaller than the cicatrix of the one large vesicle.

The writer does not propose to theorise upon this point; it is sufficient to state, for practical purposes, that not less than four vesicles should be produced, the combined

resulting cicatrices of which would not be less than one half of a square inch in area.

To ensure that the operation shall successfully produce these results, the vaccination should always be done, when possible, directly from arm to arm, and without resort to the use of stored lymph. Arm-to-arm vaccination in the hands of a good operator will be attended by the production of not less than 97 or 98 vesicles in every 100 insertions, while the use of stored lymph will reduce this success by 25 or 30 per cent. In thickly populated communities, no difficulty will be encountered in vaccinating, week by week, from the arms of children inoculated during the previous week; but in more sparsely inhabited districts, where

at three or four children would be vaccinated every week, it is better not to attempt to carry on weekly vaccination throughout the whole year, but to do so only during some portion of the year, so as to ensure a larger number of vaccinations on each day. It is often necessary, under these circumstances, to resort to stored lymph for the purpose of beginning the series, but its use should be limited to this object.

REVACCINATION.—When a person is vaccinated, complete protection is afforded against smallpox. Of this the best evidence is, that it is impossible to produce any result by the subsequent inoculation of the smallpox virus, but, as time goes on, there is a gradual return to susceptibility. This is particularly well shown in the effect which the vaccination of persons at the time of infancy has had upon the ages of death from smallpox. In pre-vaccination times, the majority of children born were attacked with smallpox before reaching the age of four years, and, after a terrible loss of life, the majority of the remainder were left protected by this attack from subsequent attack. Vaccination does not appear to produce such permanently protective results as smallpox, and, hence, the diminution of death from smallpox in early life, which has resulted from vaccination in infancy, has been attended by an increasing death-rate from smallpox amongst people of the later period. This is best shown by the following table, which is extracted from the *Forty-third Annual Report of the Registrar-General of Births, Deaths, and Marriages in England*, and which illustrates the period of life at which vaccinated and unvaccinated people respectively die from smallpox.

Proportion of deaths under and over fifteen years of age per 1,000 deaths from smallpox, in vaccinated and unvaccinated persons respectively:—

Age	Unvaccinated	Vaccinated
Under fifteen . . .	672	334
Over fifteen . . .	328	666
	1,000	1,000

The question necessarily arises during how long a period does vaccination afford protection, for it is obvious that protection can be renewed by revaccination.

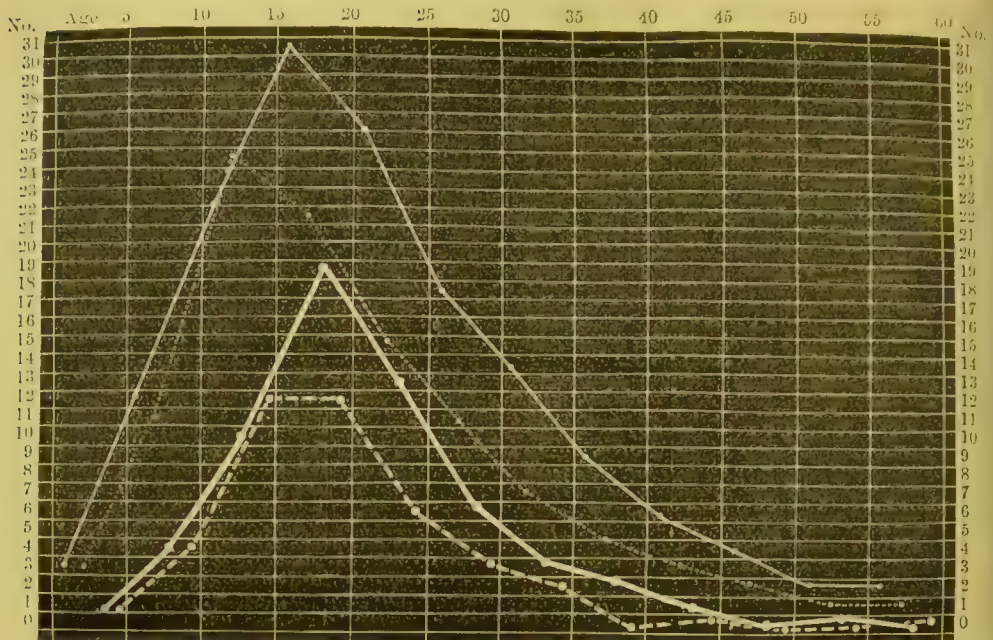
There is no doubt that this must, to some extent, depend upon conditions peculiar to the individual, but is also dependent to a very important degree upon the character of the first vaccination. This is

shown by the evidence derived from smallpox hospitals, which proves that the severity of illness of a person, suffering from smallpox, and the probabilities of death are dependent upon the number, size, and quality of the vaccination cicatrices, and the interval which has elapsed between the time of vaccination and the attack of smallpox. In this connection may be cited the statistics of Collie, Gayton, McCombie, and Marson, the three first published in the reports of the Metropolitan Asylums Board.

A lesson may also be learnt from the number of persons admitted into the smallpox hospitals with good and indifferent vaccination-marks, and for this purpose it will be sufficient to study the statistics of Dr. Gayton, which relate to the cases which came under his personal observation. The writer of the present article has constructed from these statistics the following diagram, which represents the number of males and females, with good and indifferent primary vaccination cicatrices respectively, at each quinquennial of life in each 1,000 of total admissions which were received into the hospital.

The numbers have been corrected with a view to showing what is the effect upon equal populations at each age period, and it has been assumed that the numbers of persons with good and indifferent marks in the population have been equal. As a matter of fact, the number of persons with good marks is in excess of those with indifferent marks; but inasmuch as the proportion between the two is not accurately known, it has been thought better to regard them as equal. But it may be borne in mind that in reality the diagram shows, in consequence, an exaggerated number of admissions with good marks in proportion to those with indifferent marks, but the diagram as regards males and females of each class is probably strictly comparable (p. 764).

It may be assumed for all practical purposes that the community is vaccinated, better or worse, shortly after birth, and that the increasing number of admissions, as time goes on, is due to the gradual return of these persons to a condition of susceptibility to attack from smallpox. It will be observed that, after ten years has passed, females return to this condition somewhat more rapidly than males, and that some circumstance comes into effect between ten and twenty years which checks and diminishes this increasing susceptibility. This is undoubtedly chiefly due to revaccination, but also in part to attack from smallpox; and the fact that the in-



Top line shows number of males with indifferent primary cicatrices.
 Second line shows number of females with indifferent primary cicatrices.
 Third line shows number of males with good primary cicatrices.
 Fourth line shows number of females with good primary cicatrices.

creasing susceptibility of women is checked at an earlier age than that of men must be mainly caused by these influences.

It is within the power of revaccination entirely to check this growing susceptibility, and the diagram shows that in no instance should revaccination be delayed after fifteen years of age, especially in those cases where the vaccination cicatrices are indifferent in character. Revaccination before ten years of age would largely reduce liability to attack from smallpox, and still better results would doubtless follow if revaccination, performed at this earlier period of eight or ten years of age, were repeated shortly after puberty. Whether this would permanently protect against all attack from smallpox for the rest of life must remain doubtful; and it is obvious that it is better to adopt the recommendation of the German Vaccination Commission and resort to revaccination during each subsequent ten years of life, and, if there be definite exposure to smallpox, that the operation should not be delayed till the end of this period.

The local manifestations of revaccination usually differ from those of primary vaccination. The individual is already, as a rule, partially protected against cowpox and smallpox, and the results of inoculation have only to make up the differences

between the amount of insusceptibility already obtained and total insusceptibility. In some persons, the susceptibility which remains after primary vaccination is so slight as to need only the development of papules, which last but a day or two, and then fade, or the development of vesicles may be required to give the additional protection which is needful to produce complete insusceptibility. The local manifestations of revaccination may, therefore, be little more than mere irritation—the production of a vesicle which rapidly runs through its course, becomes pustular, and is surrounded by a crust during any period of the latter part of the first week, or early in the second week; or again, of a vesicle which runs the same course as that of primary vaccination.

There is frequently seen more cedema of the arm and a larger extent of areola in revaccination than in primary vaccination; but this is probably due to the fact that in revaccination the areola generally develops earlier, and is therefore more extensive on the usual day of inspection.

PRESERVATION OF VACCINE LYMPH.—The most common methods of preservation of lymph are in capillary tubes and on ivory points. For the purpose of collection in the former, the end of the tube is inserted

into the bead of lymph which exudes after puncture of the vesicle, and the tube being held obliquely or horizontally, the lymph rapidly rises. When one-third of the length of the tube is filled, the lower end, which is in contact with the vesicle, is raised and the lymph allowed to gravitate to the centre. The moistened end of the tube is then heated in the flame of a spirit lamp, the part containing the lymph being protected by being covered by the finger and thumb holding the tube, so as to prevent the lymph from becoming coagulated or damaged by the heat; the tube thus becomes coated with charcoal, which must be burnt off in the upper part of the flame before the tube will close. The end of the tube is then melted and the tube closes; the other end is next taken between the finger and thumb, the lymph being protected in the same way. The tube is rapidly passed through the flame from the end up to the point where it is held, and, the air having been expanded and partially expelled by this means, the end of the tube is melted and closed. The effect that the tube is hermetically sealed is assured by the collapse of the melted end of the tube.

The preservation of lymph on ivory points is effected by collecting a bead of lymph on the end of the point and exposing it to the air until it has become dry. The lymph should cover the flat surface of the point as well as the extremity, and the point should preferably receive two coatings. In drying it, care should be taken that the moist surface does not come in contact with any substance which can impart dust to it. The points should be afterwards stored in close bottles. A third but less frequently adopted method of preserving lymph is by means of small square pieces of glass. The centres of two pieces of glass are brought in contact with the punctured vesicle, and the lymph is thus transferred to it. The glasses are then brought face to face with the moistened surfaces in contact with each other, and the edges are sealed by dipping them in melted paraffin. A fourth method is the preservation of undried lymph in bottles. This, however, cannot be recommended, as the lymph is very liable to decompose, and its use is attended with some risk unless but very few hours intervene between its collection and subsequent inoculation. The admixture of lymph with glycerine and with a solution of thymol or other preservative is also practised, but the data for comparing the advantages of one method over another are not sufficiently great to warrant any other recommendation

than that lymph should be preserved either in tubes or on points, as already described.

For immediate use—i.e. within a week after collection—the method of storage on ivory points is most to be depended upon. The preservation of lymph in tubes is less frequently attended by good results, most probably because of the tendency of the particulate matter to adhere to the sides of the tubes than of any alteration in its composition. For longer intervals of some weeks, tubes produce somewhat better results than points.

ANIMAL VACCINATION.—The cultivation of lymph in the calf differs from the cultivation in the human subject chiefly in the circumstance that in the calf only one hundred and twenty hours, or five times twenty-four hours, are required for the full development of the vesicle, while in the human subject one hundred and sixty-eight hours, or seven times twenty-four hours, are required for this purpose, a fact probably due to the higher temperature of the calf, which is usually from 100° to 102° Fahrenheit. The method adopted for the inoculation of the calf is as follows: A calf, which should be from three to six months of age, is placed on a table constructed so that the animal's hind legs can be separated, exposing the abdomen. This part of the body, the perineum, and flanks are shaved, and the surface cleansed by washing with a solution of carbolic acid. The lymph (which is preferably collected at the same moment from another calf) is taken on to the upper side of a rather blunt tenotomy knife, and a number of incisions, usually seventy or eighty, are made with this knife in the skin, but not through the skin; the incisions should be about an inch in length and arranged in lines, an interval of an inch being left between the successive rows, and the knife being charged with more lymph from time to time. Another method is to inoculate the calf by puncture with a small barbed instrument, grooved so as to better hold the lymph. The animal is then returned to the stable, and is provided with a collar in order to prevent it from licking the vesicles. After forty-eight hours, a papular elevation appears at the site of each inoculation, and at the end of another thirty-six hours these become vesicular, the vesicles being sufficiently developed on the fifth or sixth day for use for the vaccination of other calves or children. On the latter of these days an areola forms; lymph may, however, be taken for the same purposes after another twenty-four hours, but later it is purulent and unfit for use.

The pustules scab over, and fall between the fifteenth and twentieth days.

Lymph cannot be collected in the same manner as from the human subject. It is necessary to squeeze the vesicle, and for this purpose curved forceps with a sliding catch are used. The pressure on the vesicle ruptures it and the clear lymph exudes, and may be collected on the knife for immediate use, and on points or in tubes, as in ordinary vaccination. Animal lymph ordinarily produces in the child the same symptoms as humanised lymph. In calf-vaccination there is, however, not the same opportunity for selecting the vaccinifer from a number as occurs when humanized lymph is used, and hence calf-lymph is perhaps a little more variable in its results. It has been found, too, in the hands of some vaccinators, that if calf-lymph be introduced into a station, and used for renewing the stock, the first few children of the series have less regular results. How far this may be due to the use of lymph obtained from Continental stations, where it is collected after a less definite period than in England, is not known, for other operators have found no such results from the use of lymph cultivated in this country, where the rule is to collect lymph one hundred and twenty hours after inoculation.

By the use of calf-lymph the possibility of inoculation of syphilis is eliminated, and the risks of erysipelas reduced by the fact that it becomes unnecessary to open the vaccine vesicle of the infant for the purpose of procuring lymph for carrying on operations. Apart from this, however, erysipelas may occur, as after every wound of the surface.

The fear of inoculation of tuberculous matter by the use of animal lymph need not be entertained. The experiments of Acker tend to show that tubercle does not exist in the vaccination vesicle of tuberculous subjects, while the experiments of Jossierand at Lyons confirm this opinion. There is, moreover, the important fact that at Brussels it is the rule to examine the bodies of all calves which have been previously used for vaccination purposes, and in no single instance has tubercle been found in these calves, although some thousands have been examined. Again, in Würzburg, in the slaughterhouse, of 150,000 calves not one was found to be tuberculous. It is thus quite possible to eliminate any risk of tubercle by the selection for vaccination purposes of healthy calves in good condition. The chief disadvantage of calf-lymph is the expense involved in its production,

leading to the limitation to large centres of population of direct vaccination from calf to arm. Sparsely inhabited districts would necessarily have to depend upon the use of stored lymph, and, as a result, vaccination would be performed with less efficiency than is now possible when arm-to-arm vaccination is practised. Direct calf-to-arm vaccination of infants produced in the London Animal Vaccine Station during 1884, in the hands of two operators, 985 and 991 vesicles for every 1,000 of insertions which they respectively made. The use of stored lymph materially reduced this success. There is not, however, any positive ground for the statement that the keeping powers of calf and humanized lymph differ from each other. The experience of the above-named institution fails to show that such difference exists.

VACCINATION LAW.—In the year 1841 an Act was passed enabling every person to be vaccinated at the public cost, and in 1853 it was rendered compulsory, under a penalty of twenty shillings, that every child born after the passing of the Act, should be vaccinated, and should be brought back for inspection, under a further penalty of twenty shillings. In 1858 officers were empowered to be appointed to conduct proceedings before justices under the Acts relating to vaccination, and in 1867 a further Act was passed which repealed nearly the whole of the previous legislation, but re-enacted the chief provisions.

By the Act of 1867, unions and parishes were to be divided into vaccination districts, subject to the approval of the Poor Law Board, and the guardians were to contract with a duly qualified medical practitioner for the performance of vaccination of all persons resident within each district; the vaccinator appointed was required to possess such qualifications as were prescribed by the Lords of the Privy Council.

Other provisions were an authority for the payment of a sum not exceeding one shilling for every child successfully vaccinated, in addition to the sum paid by the guardians; the scale of fees to be paid by the guardians was not less than one shilling and sixpence, for every vaccination done at an appointed station situated at or within one mile from the residence of the vaccinator or in the workhouse of the Union; for every vaccination done at any station over one mile and under two miles distant from his residence, not less than two shillings; and for every such vaccination done at any station over two miles distant from his residence, not less than

three shillings, such distance being measured according to the nearest public carriage road; but in respect of successful vaccinations performed elsewhere than at a station or in the workhouse as aforesaid, the payment to be according to the terms specified in the contract as approved by the Poor Law Board. The fee for the revaccination of persons who may apply to be revaccinated, the Poor Law Board having issued regulations in respect thereof, to be two-thirds of the fee payable for each case of primary vaccination. No contract to be valid unless approved by the Local Government Board. The public vaccinator cannot charge for the vaccination or revaccination of any person not resident in his district:

In sparsely-populated districts, the guardians may arrange for public vaccination every three months, and no parent is to be liable for neglect to procure the vaccination during this interval, if the omission is due to the fact that the vaccination cannot be performed on account thereof.

The provisions for ensuring the vaccination of a child are the delivery of a notice by the registrar to the parent or other person having the custody of the child at the time of registration of birth, requiring the child to be taken to the public vaccinator within three months of birth for the purpose of being vaccinated, and to again take the child on the day week to him for inspection, and for him, if he sees fit, to take lymph for the performance of other vaccinations. In the event of a child being unfit to be vaccinated, a medical certificate to be necessary to postpone the vaccination for a period of not more than two months without renewal of the certificate. Children who have had smallpox, or who have been unsuccessfully vaccinated three times, to be exempt, on medical certification of either fact. The public vaccinator to sign the certificate, and, if required, to give a duplicate to the parent, and to forward the former to the registrar in whose district the vaccination shall have been performed; if the operation have been performed by a medical practitioner not being a public vaccinator, the certificate is to be forwarded to the registrar by the parent. The parent is to be liable to a penalty not exceeding twenty shillings for neglect to procure the vaccination of a child, and the public vaccinator and parent to be liable to the same penalty for neglect to perform their respective duties as to forwarding the certificate. Justices may make an order for the vaccination of a child under fourteen years of age not pre-

viously vaccinated, and any neglect of the parent to comply with the order shall render him liable to a penalty of twenty shillings. Previous notice must be given to the parent. Any person signing a false certificate to be guilty of a misdemeanour. Inoculation of smallpox is forbidden, under a penalty of not more than a month's imprisonment.

By the Act of 1871, vaccination officers are empowered to be appointed to undertake such duties previously devolving upon registrars and others; they are to receive from the registrar lists of births and deaths in his district. When a revaccinated person fails to reappear for inspection, he shall pay a fee to the guardians of two shillings and sixpence. The penalty for not producing a child, when required by a summons under the Act, is payment of a sum not exceeding twenty shillings. Complaints to be made and information to be laid for offences under the Vaccination Act within twelve months from the time when the matter of such complaint or information arose, and not subsequently. When a child has been successfully vaccinated by some one else, the public vaccinator, on the request of the parent, and after personal examination, may certify to this fact. When the Poor Law medical officer is in attendance as such upon a person suffering from smallpox, he may charge for the vaccination and revaccination of other persons in the house, as if he were a public vaccinator.

SHIRLEY F. MURPHY.

VACCINATION-SYPHILIS.—There is unfortunately no longer the least room for doubt that the pellucid lymph of a vaccine vesicle may contain the contagium of syphilis. It is not a necessary condition that blood should be drawn, or that the vesicle should be allowed to 'drain,' for if the vaccinifer be syphilitic, no precautions in these directions will give security. In saying this, it is by no means implied that such precautions are valueless; probably they are far otherwise, but they do not remove risk. Long after all doubt was past as to the possibility of conveying syphilis by vaccination, there seemed reason to hope that it could occur only when the lymph was mixed with blood or with fluid which, by draining after the vesicle was emptied of its original contents, had recently transuded from the tissues or blood-vessels. We are now, however, obliged to face the fact that these accidents are not essential, and that the virus may exist, in full potency, in lymph which is per-

fectly clear, and which has been taken with the utmost care. We owe this melancholy advance in our knowledge to the self-sacrificing enthusiasm of a public vaccinator, who repeatedly tried the experiment on himself. He selected vaccinifers who were suffering obviously and severely from inherited syphilis, and in three instances he failed, but in the fourth he succeeded. In this last experiment he produced, on his own forearm, three indurated chancres, which were followed in due course by complete syphilis. Since the greatest care was taken to use only clear lymph, and the whole details of the experiment were under the observation of skilled observers, no more evidence on this point can possibly be desired. Men engaged in the practice of vaccination have in future to realise that, under no conditions, are syphilitic vaccinifers safe, and must devote their efforts at prevention almost solely to the exclusion of such subjects from use.

In some respects it is well that the facts should have been thus simplified. If, at first sight, it may seem that the area of danger is enlarged, we may, on the other hand, feel confident that safety comes with knowledge. The open and complete removal of supposed grounds for security, which were wholly untrustworthy, can only result in reduction of risk. All that is necessary is that the facts should be made widely known.

When the syphilitic virus is conveyed in vaccine lymph, the behaviour of the sore may present certain variations. As a rule, however, with but few exceptions, if the vaccination takes, the vesicle passes through its stages and heals in the usual manner. Nothing is suspected until, at the expiration of probably about five weeks, the scar becomes irritable, and in the course of a few days enlarges into a little papule. In another week it will be hard, and subsequently will, in most cases, present all the usual features of an indurated sore. In some cases the scar may inflame in less than five weeks, but very rarely in less than a month. It does not make any difference whether the vaccination has taken or not. In each instance, the first signs of irritation in the site of the puncture occur at the same time. If it have not taken, then it is possible that all trace of a puncture may have disappeared before the syphilitic inflammation commences. When once an indurated chancre has developed, its subsequent progress will depend upon the treatment and the proclivities of the

individual. If mercury be given early, the sores will soon disappear, and but few evidences of the secondary stage will probably be witnessed. If mercury be not given, the sores may enlarge indefinitely, and perhaps coalesce, and may be attended by a good deal of inflammation. In rare cases, phagedæna may occur. Almost always there are enlarged and hard glands in the armpit, and these scarcely ever suppurate. There is no reason to believe that the virus of syphilis is ever absorbed after vaccination without the intervention of a local chancre; and, usually, the conditions of the latter are very definite, and leave no room for error. If vaccination-vesicles have passed through their stages, dried up, disappeared, and nothing more has occurred, it may be assumed as certain that there has been no introduction of syphilis. It is not without exception that an interval occurs between the healing of the vaccination vesicle and the development of syphilitic changes in its site. In some cases the sore remains unhealed throughout, and it may be acutely inflamed. In such we must suppose that pus-elements, in addition to the specific virus, have been introduced.

The constitutional phenomena after vaccination-syphilis do not differ in any respect from those of the disease when obtained in other ways. Nor is there any difference in the rules as to treatment. If mercury be given early, the primary phenomena soon disappear, and it is exceptional for any of the secondary stage to be witnessed. Some of the series of cases of syphilis after vaccination have offered unusually good opportunities for observing the laws of development of this malady, since it was known to be conveyed from the same source to many individuals at the same time. Observations on series of this kind lead to the belief that its stages, more especially that of incubation, are more uniform in duration than had been generally believed. It appears that the interval between contagion and the first signs of morbid action is very rarely less than a month, and definite induration is seldom produced till near the end of the fifth week.

It is probable that the virus of syphilis is not always present in the vaccine lymph of syphilitic vaccinifers. When it is present, it may show its vigour by producing chancres in almost all those vaccinated, and in almost all the several punctures made in each person. Multiple chancres are the rule under such conditions, and usually more punctures are infected than

escape. Yet, with such facts before us, we find that it is possible to vaccinate intentionally from syphilitic infants repeatedly with effect. No doubt this has been done unwittingly in many cases, and we may believe with confidence that it is only in exceptional instances that syphilis is communicated by vaccination, even when tainted children are used. Nor does the risk seem to be in relation with the apparent severity of the disease in the child. In two of those employed in the experiment just mentioned the disease had induced much cachexia, whereas in one of those from which a whole series of infections resulted, the vaccinifer appeared to be in excellent health.

In the all-important matter of the selection of a vaccinifer, the surgeon should carefully examine both the child and its mother, unless, indeed, he be already well acquainted with the family history. The child's nates and anus should be inspected, since sometimes eruptions or even condylomata are present on those parts in children apparently free from disease. By care in this matter, the risk may be reduced to a minimum; but it must still be admitted to be possible for both mother and child to be free from any suspicious symptoms, whilst syphilis is yet present. It is well, therefore, to adopt the rule of never employing a first-born child. If there be one or more healthy elder children, and the child itself and its mother are free, then it may be regarded as practically certain that no taint exists.

Although vaccination-syphilis is a reality, and unquestionably demands our utmost surveillance for its prevention, yet it is fortunately very rare. Since the several series of cases which the writer recorded about ten years ago, not a single instance of it has come within his knowledge, nor have any been mentioned to him by his professional friends.

JONATHAN HUTCHINSON.

VAGINA, Affections of the.—The vagina, extending from the vulva to the uterus, is lined by mucous membrane continuous with the investment of the external organs of generation. Anteriorly, the canal is intimately united below with the urethra, and above with the base of the bladder (*vesico-vaginal septum*); while, posteriorly, it is connected more or less closely below with the anterior surface of the rectum (*recto-vaginal septum*), but lies for the upper third of its extent in immediate relation to the peritoneum lining Douglas's space. The *vulvar orifice*, which is the narrowest part of the vagina, is partially

closed in the normal virgin state by a membranous structure termed the *hymen*, of which the remains after rupture constitute the tubercles known as *carunculæ myrtiformes*, found seated around the entrance of the canal.

I. **MALFORMATIONS**, whether congenital or acquired, owe their chief clinical importance to the obstruction which may be offered to the free escape of the menstrual fluid. But, short of this, they may interfere with coitus, or even impede the passage of the child in the event of pregnancy and labour.

1. *Congenital malformations* resulting from defective development, or from subsequent closure during fetal life of a part of the canal by inflammatory processes:—*Complete absence of the vagina* is an extremely rare condition, usually although not invariably associated with imperfect development of the uterus and ovaries, and hence less likely than some other minor malformations to call for active surgical interference. *Septate or double vagina* is another deformity of very rare occurrence, characterised by the existence of two distinct canals separated by a more or less complete vertical septum, and often communicating with a bifid uterus, of which one horn is commonly more developed than the other. *Partial occlusion (atresia)* of the vagina may be due to an obstruction seated in the upper or middle third of the canal, or more frequently immediately within the orifice. But the most common form of occlusion is that known as *atresia hymenalis*, from the presence of an imperforate hymen.

2. *Acquired malformations*, resulting from cicatricial bands or septa, may present almost any degree of constriction, from partial narrowing up to complete obliteration of the canal. Among the causes producing them may be mentioned extensive sloughing after parturition, or consequent upon diphtheritic or other severe inflammations, surgical injuries, &c.

IMPERFORATE HYMEN is the malformation which most frequently requires active surgical interference, on account of obstruction to the escape of menstrual discharges. In the normal virgin state, the hymen, a thin fold of mucous membrane, is either crescentic forwards or else diaphragmatic with a central aperture; but, in the condition under consideration, the vaginal orifice is closed by an imperforate membrane of a dense and often extremely tough structure.

Symptoms.—As a rule, the malformation does not excite attention until the age

of puberty, when the non-appearance of the menses, coupled with the recurrence of successive monthly attacks of pelvic pain and severe constitutional disturbance, usually leads sooner or later to investigation.

Diagnosis.—Inspection reveals a tense bulging membrane filling the orifice of the vagina; and, on rectal examination, the pelvis is found occupied by a firm elastic tumour, which abdominal palpation will usually detect rising to a variable height above the level of the pubes, often bearing upon its summit a small firm body recognisable as the uterus.

Prognosis.—The condition, if unrelieved, almost invariably proves fatal by hæmorrhage or by septic peritonitis, resulting from rupture of a distended uterus or of a blood-sac in a Fallopian tube. Occasionally, however, the obstructing membrane may give way, and allow the escape of the fluid imprisoned in the sac formed by the distended vagina.

Treatment for Retained Menses.—In all cases, two main sources of danger connected with the operation required have to be kept in view. The *first* of these, arising from too rapid collapse of the distended sac, is due to the risk thereby entailed of rupture of the Fallopian tubes or of vascular adhesions connecting them with the pelvic walls. This accident, liable to prove fatal by septic peritonitis or by hæmorrhage, should always be guarded against by avoiding any abdominal pressure upon the sac while its contents are escaping. The *second* source of danger referred to is that of septicæmia following the operation, as the result of decomposition of the discharges, a complication which may be averted by the maintenance of efficient drainage and the use of antiseptics.

Operation for Imperforate Hymen.—The best time to select for its performance is midway between two menstrual periods, as indicated by the recurring catamenial molimina. The patient, after anæsthesiation, should be placed in the usual lithotomy position, and the parts then be thoroughly cleansed with 1-20 carbolic lotion. The protruding membrane is next punctured with a full-sized trocar, previously immersed in carbolised oil, and the fluid, usually of a dark colour and thick tarry consistence, must be allowed to escape slowly. On its ceasing to flow, the canula is withdrawn, and the opening freely enlarged by a cruciform incision made with a blunt-pointed bistoury. The cavity should now be gently washed out

with a warm antiseptic solution (carbolic acid or corrosive sublimate); and, if thought desirable, a short, full-sized, glass or vulcanite drainage-tube may be inserted. Finally, a thick pad of some absorbent antiseptic material is applied to the vulva. The patient must be confined to bed for some few days after the operation, during which time the dressing should be changed, and the vagina syringed out, twice or oftener in each twenty-four hours.

Operation for Partial Occlusion of the Vagina.—Having first passed a sound into the previously emptied bladder, the surgeon introduces his left index finger into the rectum in order to ascertain the extent and depth of the occluding tissue, as well as the exact position of the distended sac.

After satisfying himself on these points, he entrusts the sound to an assistant, and, with his finger still in the rectum to act as a guide, makes a horizontal incision between the labia, carefully dissecting through the tissues until the sac is reached. This is then punctured and evacuated, with the same precautions as in the above described operation. The cavity having been carefully washed out, is loosely packed with strips of lint soaked in carbolised oil, or with iodoform gauze, and an antiseptic pad is applied externally. The plugs, which require renewal every six or eight hours during the first few days, may then be replaced by a perforated glass or vulcanite tube, which should be worn more or less continuously for a week or two, in order to avoid contraction and closure of the newly-made orifice.

The malformation known as *septate vagina* may require surgical interference for relief of menstrual accumulation, in connection with one or other horn of a bifid uterus. The treatment of such a condition (termed *hæmato-kolpos*) would resemble that above described.

The operation for *complete absence of the vagina*, independently of any menstrual retention, is justifiable only in cases where it is possible by combined exploration of the rectum, the bladder, and through the abdominal wall, to ascertain clearly the existence of a well-developed uterus and ovaries. The procedure required is a much more difficult one than any of the above, owing to the fact that the surgeon will possess no other guide to his incision than the position of the cervix; in all other respects the operative details are the same as in the cases of partial occlusion of the canal.

Partial septa, either congenital or acquired, occasionally necessitate interference. They are best divided by means of the thermo-cautery, care being taken to avoid injury to the vaginal wall.

II. SURGICAL INJURIES.—1. *Wounds of the vagina* always result from direct violence, accidental or intentional. Their immediate gravity in any case depends upon whether the peritoneum has escaped injury.

Their *causes* may be various, including falls upon upright pointed objects; violence inflicted by thrusting foreign bodies into the canal; the passage of instruments for purposes of abortion; or the unskilful use of the same during labour.

Superficial wounds of the vaginal wall, not involving the peritoneum, usually give rise to very free hæmorrhage, which may require for its arrest the introduction of a firm plug of some antiseptic material. If extensive laceration have occurred, points of suture may with advantage be inserted as required. Rest in bed and the frequent use of antiseptic injections will readily promote healing. Any subsequent tendency to faulty cicatricial contraction must be combated by the occasional introduction of a well-sized cylindrical speculum.

Wounds involving the peritoneum are necessarily of a far more serious nature. Their infliction always gives rise to more or less serious collapse, often succeeded by symptoms of septic peritonitis, which may rapidly prove fatal.

Treatment.—Small *punctured wounds* are best left alone, nothing being attempted in the way of local management beyond the free application of iodoform powder to the surface of the vagina, followed by the introduction of a plug of iodoform gauze, which should be renewed daily. In cases of *extensive injury* to the peritoneum, it is best, as a rule, not to attempt the introduction of any sutures, but to trust to the readiness with which the serous membrane will unite on mere apposition of its torn surfaces. Should the intestine have protruded, it must be carefully cleansed with warm carbolised lotion before being returned to the abdominal cavity. In any case of wound of the peritoneum, the patient should as quickly as possible be brought well under the influence of opium, and be kept until all risk of peritonitis is over.

2. *Foreign bodies* sometimes require to be removed from the vagina. These may have been wilfully introduced by the patient herself; or may consist of pessaries originally placed there under medical supervision, and subsequently neglected. In

either case, their presence in course of time gives rise to pain, irritation, and puriform discharge, and may ultimately lead to ulceration, followed by the formation of a fistula. Removal of a foreign body must be effected with care, in order to avoid laceration of the vaginal wall. If large, it may require to be broken up with strong nippers and then taken away piecemeal.

III. INFLAMMATION OF THE MUCOUS MEMBRANE of the vagina (*vaginitis, colpitis*) occurs in the *acute* form either as a simple or as a specific affection.

Causation.—*Simple vaginitis* arises primarily from severe irritation of almost any kind, whether of a chemical or mechanical nature. It may also result secondarily from acrid uterine discharges, from secretions due to carcinomatous affections, from the irritation produced by urine or fæces in cases of vaginal fistulæ, or from that caused by the continued presence in the passage of any foreign bodies, such as tampons, sponges, ill-fitting pessaries, &c.

Specific vaginitis is usually caused by direct gonorrhœal infection; but it may also be found as a concomitant of chancreoid affections of the external genitals.

A variety known as *diphtheritic vaginitis* is occasionally met with in badly-nourished unhealthy women during the puerperal state, or again in the course of typhus, smallpox, or scarlet fever.

All forms of acute vaginitis, with the exception of that last mentioned, are exceedingly liable to become *chronic* if long unrelieved. The gonorrhœal variety especially is often of the most intractable type, and is moreover dangerous from its tendency to spread to the uterine cavity.

Symptoms and Diagnosis.—In both the simple and the specific form of vaginitis the prominent subjective symptoms are a sense of heat and aching pain about the part, with great discomfort and tenderness on locomotion. On examination, the vaginal mucous membrane is found reddened, inflamed, and swollen, often granular in appearance, and covered with a profuse cream-coloured or greenish puriform discharge. When due to direct gonorrhœal infection, the disease is usually accompanied in the early stage by more or less acute inflammation of the vulva, and not uncommonly by some amount of urethritis, giving rise to frequent and painful micturition. The differentiation, however, between the simple and gonorrhœal varieties cannot with any certainty be made from the physical signs alone, apart from the history.

Treatment, during the *acute* stage of the disease, consists in the administration of a free mercurial purge, followed by a course of diuretic salines with tincture of hyoscyamus, the patient meanwhile being confined to bed and kept on light diet. The vagina should be well douched every four or five hours with a warm solution of acetate of lead in decoction of poppies, or with a lotion containing half an ounce of borax to the pint of warm water. This may be replaced in time, as the acute symptoms pass off, by the use of a colder solution containing tannin or alum in the proportions of one or two drachms to the pint. A remedy often employed with advantage in the *subacute* stage consists of a solution of nitrate of silver (℞j.-iij. ad ℥j.), which should be freely applied to the entire vaginal surface once in every three days.

Should the affection be seen in the *chronic* stage, the daily use of an astringent injection, followed by the introduction of a vaginal suppository, containing twenty grains of iodoform powder, will constitute the best mode of treatment.

IV. TUMOURS AND PROLAPSE.—*Fibroid growths* in the substance of, or dependent from, the anterior vaginal wall are extremely rare. Removal by enucleation after incision of the capsule, or, if the growth be polypoid, by division of the pedicle with scissors or the thermo-cautery, may be readily effected.

Cysts, varying in size from that of a small cherry to a bantam's egg, may occasionally be found seated on the anterior vaginal wall, within a short distance of the orifice. As a rule they occur singly, but two or more may be met with. They are thin-walled, and usually contain a clear, glairy fluid; but, in some instances, the contents are of a semi-gelatinous consistence, and dark chocolate in colour. Their mode of origin is doubtful.

Unless of any size, they give rise to no special symptoms. On examination, their recognition is easy from the smooth, elastic, and globular nature of the swelling. If small, the cyst may be removed entire by means of a little careful dissection. Another plan of treatment consists in freely laying open its cavity, and cauterising the lining membrane, which subsequently granulates.

Sacculated dilatation of a portion of the urethral canal gives rise to an oval-shaped swelling, of which the position and reducibility on pressure will reveal the true nature.

Treatment consists in removing an elliptical portion of mucous membrane, with its long axis in the direction of the urethra, and approximating the edges of the incision with sutures.

Prolapse of the vagina may be *partial*, involving chiefly the anterior wall (*cystocele*), or more rarely the posterior wall alone (*rectocele*); or it may be *complete*, when both walls are everted with descent of the uterus—a condition often preceded by, although not essentially dependent upon, perineal rupture. The exciting factor in all cases of prolapse is intra-abdominal pressure, commonly resulting—in patients predisposed thereto—from habitual neglect in obeying the calls to evacuate the bladder or rectum. *Partial* protrusions require the employment of suitable vaginal supports, combined with the use of astringent injections or pessaries, and careful regulation of the patient's habits. *Chronic* cases of more or less irreducible prolapse may demand operative treatment with the object of contracting the vaginal orifice, which can best be effected by the usual operation for ruptured perineum, combined with excision of a portion of the redundant mucous membrane of the posterior vaginal wall.

Other procedures which aim at producing cicatricial contraction, or even closure of the canal, rarely prove of any lasting benefit to the patient.

V. NEW GROWTHS.—*Malignant disease* occurring primarily in the vagina is extremely rare. When met with, it consists either of a localised, broad-based, papillomatous growth usually seated on the posterior wall, or else of a diffused carcinomatous infiltration, sometimes leading to constriction of the canal. Early infection of the inguinal glands commonly takes place.

Diagnosis and Symptoms.—The *papillomatous* form is most frequently seen in aged women, and is usually painless in the early stage, but later on gives rise to a certain amount of fetid discharge, with occasional hæmorrhages. The *diffused* variety, met with in younger women, is very often found to be secondary to uterine cancer.

Treatment.—The frequent use of a dusting powder composed of equal parts of tannin and iodoform will serve to control hæmorrhage and discharge, in addition to promoting the patient's comfort by diminishing fetor. If operative interference be deemed advisable, the diseased tissues must be excised as freely as possible with the help of the thermo-cautery.

Sarcoma of the vagina has been described as occurring either in a diffuse form or as circumscribed nodules. The affection is one of great rarity. Extirpation of the growths may be attempted.

W. A. MEREDITH.

VAGINAL FISTULÆ in connection with the urinary apparatus are named, according to their situation, *urethro-vaginal*, *vesico-vaginal*, *vesico-uterine* (where the fistulous tract traverses the anterior lip of the cervix to open into the cervical canal), and *uretero-vaginal* (where direct communication exists between a ureter and the vaginal canal). Of these four varieties, the first two mentioned are very rare, the last extremely so.

In the form known as the *vesico-vaginal*, which is by far the most commonly met with, the fistulous opening may be found at any point of the vesico-vaginal septum, varying in size from a minute slit to a large oval or somewhat quadrangular aperture. The margin, at first irregular, swollen, and ulcerated, subsequently, in the course of cicatrization, becomes thin and firm. In long-standing cases, where the urine escapes readily, the bladder may in time become permanently contracted, the urethra also undertaking of the same change from long use.

Causation.—Apart from malignant disease, which is the most common cause of vesical fistula in this situation, the majority of cases result from injuries inflicted during parturition, either by direct laceration, or indirectly from sloughing due to prolonged pressure in tedious labours. Occasionally, ulceration set up by the presence of a foreign body may act, in a somewhat similar way, as a cause.

Symptoms.—The leading feature in all cases of vesico-vaginal fistula is the incontinence of urine. In puerperal patients this symptom, unless when due to direct laceration, may not ensue for some days or even for a week or two after delivery, its occurrence depending upon the separation of the slough caused by the injury. When the fistula is established, the flow will vary in quantity according to the position of the fistula; thus, if the opening be seated high in the lower portion of the bladder will retain a certain amount of urine, and no overflow may occur so long as the patient is erect, although escape at once takes place if she lies down; on the other hand, if the opening be near the neck of the bladder, incontinence will probably be a more or less constant symptom.

Diagnosis.—The chief difficulty of this may lie in ascertaining the exact seat of the fistulous opening. When of any size, its existence on the anterior wall of the vagina can be readily recognised by digital touch, confirmed, if necessary, by the passage of a sound into the bladder and thence into the vagina. But small fistulæ often require the use of considerable care for their detection, either in consequence of the minute size of the aperture, or from the fact of its being concealed beneath a fold of mucous membrane. Should careful inspection, after thorough exposure with the help of a duck-bill speculum, fail to discover it, resort may be had to the plan of gradually distending the bladder by the injection of milk or of some coloured solution, of which any escape through even the smallest opening in the anterior vaginal wall would be readily detected. If no evidence of leakage be seen, a careful examination of the cervix uteri should be made to discover the existence of a fistulous tract.

Treatment.—Small fistulæ, when recent, will often close naturally, provided that rigid cleanliness be observed, and the bladder be kept relieved by the use of the catheter. Even when of some size and standing, their closure may occasionally be effected by cauterisation, but, as a rule, operative measures are required. These are most likely to succeed when undertaken within two to three months after the occurrence of the injury, by which time the tissues will have acquired sufficient soundness without being too firmly cicatrised. In all cases, before anything be attempted, the patient's general health must be attended to, while the parts involved should be brought into as healthy a state as possible.

Three main points require to be observed in the performance of the operation.

1. *The fistulous opening should be completely exposed, in order that its position and extent may be kept well in view throughout the procedure.* For this purpose it is well to have the patient anaesthetised, although as a rule the operation is not a painful one. The first essential is a good light, in front of which the patient should lie in the usual lithotomy position, but with the hips raised to a somewhat higher level than the shoulders, while the thighs are forcibly flexed upon the abdomen. If preferred, she may be placed in the lateral or semi-prone position. The vagina having been well cleansed, a full-sized duck-bill speculum is introduced and maintained firmly in position, so as to retract the perineum and posterior vaginal wall, and allow

free exposure of the vesico-vaginal septum. A sound in the bladder will serve to depress the anterior vaginal wall, thus bringing the fistula within more easy reach; or the same object may be attained by drawing down the cervix uteri by means of a vulsellum or a thread.

2. *The margins of the fistula should be thoroughly pared, so as to obtain a continuous raw surface.* In doing this, the operator, with the help of a tenaculum or fine-toothed forceps, first seizes and puts on the stretch some portion of the marginal mucous membrane. This is next transfixes with the knife in such a way as to split the vaginal layer through the edge of the fistula, and the knife is then carried laterally right and left, so as, if possible, to remove a complete circle of mucous membrane of the desired extent, leaving a continuous border of denuded surface around the opening on its vaginal aspect. If much cicatricial tissue be present, the margin must be more freely pared, even to the extent of removing a rim of vesical mucous membrane; but as a rule this latter should be avoided, in order to prevent risk of after-hæmorrhage into the bladder. The edges having been thoroughly denuded in the way described, or, if preferred, by means of scissors in place of the knife, all oozing must be arrested by the use of ice or of the hot douche.

3. *The sutures are to be introduced, and the freshly pared surfaces brought into accurate apposition so as to completely close the opening.* The best and most manageable material for the sutures is stout silk worm gut, but silver wire is also much used. They may be introduced by small curved needles fixed in a needle-holder; or, if preferred, by means of a handled needle, which is to be threaded after its passage and before being withdrawn. In any case, the needle should be entered about one-third of an inch from the edge of the abraded surface, and be made to transfix both margins of the opening in close proximity to, but without actually piercing, the vesical mucous membrane. When the tissues are dense, its passage may be facilitated by using a blunt hook to afford counter-pressure at the point of exit. The sutures are to be placed at intervals not exceeding a quarter of an inch, care being taken to introduce them evenly, so as to prevent subsequent puckering of the edges. After a sufficient number have been passed and all bleeding has ceased, the raw surfaces are carefully dried with a sponge, and brought into apposition by traction on the sutures, which are then firmly tied, their ends being left long and

looped together to facilitate subsequent removal. If silver sutures have been employed, they may be either tied or twisted; or, if preferred, the ends may be passed through a Bozemann's plate and clamped with split shot.

After-treatment.—The bladder should be kept empty by means of a self-retaining vulcanite catheter with tubing attached, or else the urine may be drawn off at frequent intervals by the nurse. Some operators, however, allow the patient to empty the bladder naturally from the first. During convalescence, the vagina must be well douched twice daily with some antiseptic solution. The bowels, as a rule, are to be kept quiet by means of opium for a week or ten days, after which they may be relieved by the use of oil and gruel enemata. The sutures usually require removal on the sixth or seventh day, but, if not causing irritation, they may with advantage be left for a few days longer.

The *less common forms* of vesical fistulæ will require operative treatment varying according to their seat and extent. Thus, for the closure of an opening *in close proximity* to the cervix uteri, it may be necessary to make use of the anterior lip; or if this have been extensively destroyed, the posterior one may have to be brought into requisition by an operation involving obliteration of the os uteri, and thus leaving the uterine cavity to open into the bladder.

In the case of a sinus traversing the cervix (*vesico-uterine*), the anterior lip should be split through in order to fully expose the fistulous tract, which must be freely denuded before re-approximating the opposed surfaces by means of deep sutures.

When *direct* closure of a fistula is impossible owing to very extensive loss of tissue, an operation termed 'kolpoplexis,' consisting in transverse obliteration of the vagina *below* the seat of the opening into the bladder, may be deemed justifiable as the only means of relieving the patient. This object is effected by the removal of a complete ring of mucous membrane from the vaginal wall, and the subsequent coaptation of the denuded surfaces by the help of sutures, until firm union has taken place.

RECTO-VAGINAL FISTULA commonly arises from carcinomatous or syphilitic disease of the rectum, in neither of which cases would it be amenable to operative treatment. It may occasionally, however, result from sloughing, consequent upon injuries of the same nature as those which lead to vesical fistulæ. The symptoms com-

plained of are due to the passage of flatus and *fæces per vaginam*.

Treatment consists in paring the edges and closing the opening with sutures, which must not include the rectal mucous membrane. The bowels should afterwards be cleared rather earlier than in the case of a vesical operation, in order to obviate danger arising from scybala. W. A. MEREDITH.

VAGINAL HERNIA.—In this variety the rupture projects into the vagina. It usually protrudes through the lateral wall of the vagina behind the broad ligament. It may be found in front of the broad ligament, or deep down in the recto-vaginal pouch. The rupture is most often seen in multiparæ. The contents are usually small intestine. In at least one instance a loop of the sigmoid flexure is said to have been involved. So far as reported cases go, it does not appear to have been the subject of strangulation. The tumour may form a serious obstacle in labour.

FREDERICK TREVES.

VAGINAL LITHOTOMY. *See* LITHOTOMY; STONE IN THE FEMALE BLADDER.

VAGINISMUS is a term applied to a condition occasionally met with in married women of a nervous, irritable temperament, arising from the presence of some persistent local source of irritation about the vulva or the orifice of the vagina. Among such may be mentioned:—Vascular growth of the meatus; fissures of the fourchette or nymphæ; irritable carunculæ myrtiformes; an inflamed or only partially ruptured hymen, &c.

The chief *symptom* of the disease is intense pain and spasm of the parts, induced by any attempt at coition.

Diagnosis must be made by inspection, a careful search being instituted for the discovery of any one of the above-named sources of irritation. Should no local cause be found, the possibility of the symptoms depending upon some internal condition, such as a tender prolapsed ovary, or upon the existence of perimetritic trouble, must be considered.

Treatment will consist in the removal of any local source of irritation.

Vascular growth of the meatus should be destroyed with the help of the thermo-cautery.

Fissures of the fourchette, or around the vaginal orifice, are best treated by division with a sharp knife, or by the application of the cautery, followed in either

case by the use of an ointment containing iodoform.

The condition known as *irritable carunculæ myrtiformes* is recognised by the presence of extremely sensitive, nodular projections on the surface of the mucous membrane immediately within the orifice of the vagina; these consist of the remains of the ruptured hymen. In order to obtain a cure in such cases, it is necessary to remove a complete ring of tissue, including the growths in question. This should be effected, with the help of sharp curved scissors, while the patient is under an anæsthetic. The vaginal orifice must next be freely dilated, and then firmly plugged with a roll of iodoform gauze, over which a pad of the same material is to be applied and kept in place by a T-bandage. The use of a self-retaining catheter, with rubber tubing attached, will prevent soiling of the dressings. The plug which, in addition to acting as an efficient dilator, is also a perfect antiseptic, may be left undisturbed for five or six days, when, on its removal, the raw surface will be found healed. The subsequent daily employment, for a few hours, of a glass or vulcanite dilator will prove useful in completing the cure.

A somewhat similar treatment may be followed in cases of an *abnormally tough* or only *partially ruptured hymen*, in newly-married women. W. A. MEREDITH.

VARICOCELE.—This term was formerly used to denote a varicose condition of the superficial veins of the scrotum, and **CIRCOCELE** was the name given to varix of the veins of the spermatic cord. Circocoele has become obsolete, and varicocele is always used at the present time to denote a dilated varicose condition of the spermatic plexus of veins.

Causes.—The disease is most frequently seen between the periods of puberty and full manhood. Cases are occasionally observed in young boys and just before puberty, and the writer has operated upon a man fifty-four years of age, who attributed the development of the varix, and apparently with reason, to a blow received seven months previously. The disease is therefore, probably, in some way associated with the great developmental changes occurring in the testicle at puberty, and the functional excitement of the parts during the years of early manhood. Frequent masturbation, or a lascivious habit of mind, by keeping up a more or less constant congestion of the part, may favour the

development of varicocele; on the other hand, the regular sexual relations of marriage are of use in curing the disease when slight. The more definite local causes of varicocele are the great length and vertical direction of the slender spermatic veins, their plexiform arrangement in the scrotum, with their termination in one, or at the most two, small veins in the abdomen; the imperfect support afforded to the veins by the loose tissues of the scrotum; the great vascular changes attending sexual excitement; injury; and acute inflammation of the epididymis and cord. Occupations involving continuous standing or slow walking, or attended with frequent concussions of the parts, and hot climates are believed to predispose to the venous dilatation, while there is evidence to show that general debility, with a feeble state of the circulation, and a relaxed flabby condition of the tissues, leading to a pendulous condition of the scrotum, is of etiological importance. In a large proportion of cases, the subjects of varicocele are healthy, well-nourished, and well-developed men, in whom it is impossible to detect any cause of increased intravenous pressure, or of deficient external support. In such cases, the writer has suggested that the disease is to be regarded as a true venous hypertrophy, arising during the active changes occurring in the associated organs at and after puberty.

The much greater frequency of varicocele on the left side than the right has been accounted for by the greater length of the left vein, by the fact that the left spermatic vein enters the renal vein at right angles, while the right opens into the vena cava parallel to its current, and by the passage of the left vein under the sigmoid flexure, which, when loaded with feces, may compress and obstruct it. It must be confessed, however, that, with the exception of the greater length of the left vein, no valid reason for the undoubted fact has been as yet adduced, and even this does not appear to be sufficient to account for the remarkable preponderance of left-sided varicocele. The occurrence of varicocele has also been attributed to the absence of valves in the left spermatic veins; in addition, however, to several valves in different parts of these veins, a single valve, or a pair, are found at, or within a very short distance of, the outlet of the vein on each side; it is easy to demonstrate the competency of these valves, and the impossibility of injecting fluid from the renal vein or vena cava into the spermatic vein.

Pathology.—The affected veins are dilated, pouched, elongated, and tortuous; their walls are thickened with an overgrowth of fibrous and muscular tissue, to such an extent that when cut across they stand open like arteries. Probably all the veins of the spermatic cord are never affected, and the degree to which the dilatation progresses in different veins, and in different cases, varies much. The venous dilatation has been shown to extend to the vessels of the mediastinum testis, and to those lying beneath the tunica albuginea. Localised thrombosis, with the subsequent formation of a phlebolith, may occur. The most important pathological question arises in connection with the testicle. That organ is most often found of its natural size and plumpness, and apparently unaffected by the presence of the varix. In some cases the testicle is a little smaller and softer than its fellow, and in a certain number of cases the testicle is found markedly smaller than its fellow, but of the normal shape and consistence. The explanation of these facts is probably as follows:—If the disease be limited to the cord, as is usually the case, and come on after the testicle has reached its full development, it exerts no injurious influence upon the structure of that organ. But when the vessels within the testicle are varicose, it may lead to a slight shrinking of the tubular structure. If, however, the varices develop before or at puberty, the usual enlargement of the testicle may not take place, and it may continue in its puerile state. The important fact is, that where the testicle is found much smaller than its fellow, it is an undeveloped organ, and not atrophied. There is no evidence that simple varicocele can produce marked wasting of a healthy testicle. Similarly, it appears probable that a varicocele does not interfere with the due elaboration of semen, or render its subject either impotent or sterile. Mr. Curling cites three cases in which the spermatic fluid was found destitute of spermatozoa; but, as in each of these cases the testicle was distinctly small, it is probable that they were instances of the association of varicocele with failure of development of the testicle.

The superficial scrotal veins may be found varicose, and occasionally there may be varices of the superficial veins of the legs. In the worst cases of varicocele, the scrotum is usually very pendulous.

Symptoms.—There may be no subjective symptoms whatever attendant upon even a very large varicocele; the patient,

in such cases, is at the most only conscious of a greater fulness of the left than of the right side of the scrotum, and it is not uncommon for the surgeon to discover a varicocele of which the patient has been quite unconscious. In the majority of cases the patients complain of a sense of weight in the scrotum, and of a dragging pain, extending up into the groin and round to the loin of the same side; this is exaggerated by standing, by effort or by fatigue, and is relieved by rest in the horizontal position, or by support to the scrotum. The frequent or constant occurrence of this pain exerts a markedly depressing influence upon some minds; it also tends to centre the thoughts of the individual upon his sexual organs, excites groundless fears of impotence or sterility, and if the man be deficient in moral control, he may become a sexual hypochondriac. In some rare cases the pain has been so intense that the patient has been quite disabled, apart altogether from emotional disturbance. The pain may be only felt, or felt most, when the bowels are constipated, and it is greatly exaggerated after sexual intercourse, although at the time relief may be experienced. It is a common belief that varicocele may cause frequent seminal emissions; but careful inquiry has shown this to be groundless.

Diagnosis.—Varicocele is generally present on the left side only, and, if present on the right, the left swelling is the larger of the two. The diagnosis is usually made with the greatest ease. The swelling involves the cord, and in many cases projects behind and even below the testicle, but is limited to the scrotum, not extending up into the groin. It is soft, elastic, opaque, compressible, dull on percussion, with a distinct expansile impulse on coughing, and the irregular tortuous veins give to it the feel of a bag of worms. If the patient lie down, the swelling is reduced by simply raising the scrotum, and without a gurgle, or the sensation of a sudden slip, as in the reduction of a hernia. If now the surgeon place his forefinger lightly over the external abdominal ring, and allow the patient to rise, he will observe the gradual reappearance of the swelling first at the lower part of the scrotum, and without his feeling anything slip past his finger. This sign, and the fact that the swelling is limited to the scrotum, will readily distinguish varicocele from hernia, for which it has been most often mistaken; the impulse on coughing, the knotty feel of the swelling, and its ready reducibility distinguish it at once from the oedema of the

cord produced by wearing a truss, or the thickness due to the presence of the sac of a hernia.

Treatment.—The first thing to be done in most of the cases coming under the surgeon's notice, is to assure the patient of the innocuousness of the disease—that it will not induce impotence, sterility, or exhausting seminal emissions. If the surgeon is successful in quieting the patient's mental distress, it is not uncommon for all physical distress to pass off too. Where, however, pain is complained of, palliative measures should be adopted. The patient should constantly wear a well-fitting suspender, of which the best is probably one that laces up the front; another good one is that which raises the scrotum into the left groin by a strap fastened to a band round the waist. Night and morning the scrotum should be well douched with cold water, to improve the 'tone' of the dartos. The bowels should be carefully regulated, and if the patient be pale, anæmic, and flabby, the perchloride or other preparation of iron should be given, and moderate outdoor exercise should be insisted on. Severe exertion, or sudden strains, are to be forbidden; but it is most essential to avoid leading these patients to consider themselves to be invalids, or unfitted for the active duties of life; the more they can be absorbed in their occupations, and the better their general health is maintained—by whatever means—the less distress will a varicocele occasion. All vicious practices must be absolutely abandoned, too frequent seminal emissions should be controlled by bromide of potassium, in doses of ʒss., given at bed-time. In some cases a well-fitting truss, maintaining gentle compression on the spermatic veins in the inguinal canal, affords more relief than a suspender, and leads to the gradual shrinking of the varix; it is, however, difficult to adjust a truss with just the right amount of force. When the presence of a varicocele debars a youth from one of the Government services, or from any particular occupation; when the subject of it wishes to live in a hot climate; when palliative measures fail to give relief, and the varix is increasing, or has attained a large size; when the testicle on the same side is notably smaller than its fellow; a radical cure of the varicocele should be attempted. It is probably well to operate upon all varicoceles present before puberty; but in no case is the operation to be recommended until palliative means have failed to give relief, and unless the varicocele is a cause of distinct

inconvenience to the patient. The operation should not be undertaken simply for the relief of the mental distress so often associated with this disease.

Many operations for the radical cure have been devised and practised, but only three require notice here:—(1) The simplest procedure is to pass a straight needle, armed with carbolised silk or chromicised catgut, through the scrotum, between the vas deferens and the veins, and then back again between the veins and the skin, so that the dilated vessels are enclosed in a subcutaneous loop. The thread should then be tied tightly, and the ends cut off short and allowed to slip inside the scrotal puncture. Some surgeons prefer to place two such ligatures round the veins, about an inch apart. (2) Excision of the veins. The part is shaved and rendered aseptic by thorough cleansing with turpentine, corrosive sublimate 1-500, or carbolic lotion (5 p.c.); a small fold of skin, over the front of the varix, is raised and transfixed; the large veins at once appear, and are to be cleaned, carefully separated from the vas deferens, and any small, undilated veins, ligatured at the upper and lower end of the exposed part with chromic catgut, and the intermediate portion excised. The skin-wound is to be carefully sewn up with a continuous suture, and a small drain placed in the lower end of the wound. The whole operation, and the subsequent dressing, should be conducted aseptically. This operation certainly cures the disease, and if the above-named precautions be taken, is a safe measure; but the writer has known it to be attended with suppuration, and with extensive hæmorrhage from slipping of a ligature; he, having performed it a few times, has come to regard it as inferior to the following procedure. (3) Subcutaneous division of the veins with a galvanic *écraseur*. The vas deferens is to be carefully separated from the veins at the upper part of the scrotum, and the skin pinched in between the two is to be transfixed with a tenotome or some slender knife, and divided parallel with the vas for $\frac{1}{2}$ inch. Through this incision, a needle, armed with a platinum wire, is to be passed, and returned through the same skin-apertures, but between the skin and the veins. The veins are thus secured in a loop of the wire. The ends of the loop are to be affixed to an *écraseur*, and the current of one cell of a Grove's battery, or of a small bichromate battery, passed through it; the heated wire quickly severs the veins and securely sears the cut ends. A moderate traction should

be kept up on the wire, so as to draw the veins out of the scrotum as much as possible, and in that way the action of the hot wire is limited to the veins; the wire must be heated to a dull red colour only. The patient must subsequently rest quiet and still in bed, with the scrotum supported and a small pledget of iodoform wool over each skin-wound. The veins will be felt to become filled with clotted blood, which gradually becomes absorbed. As a rule, the patients are kept in bed for a week, and are able to resume active duties in ten to fourteen days; they should wear a suspender for another month. Having performed this operation about twenty-five times, the writer can strongly recommend it, on account of its ease, safety, painlessness, and the certainty with which a cure is obtained. The radical cure of a varicocele, by any one of these methods, is not attended with danger to the testicle.

A. PEARCE GOULD.

VARICOSE ANEURISM. See ARTERIO-VEINUS ANEURISM.

VARICOSE VEINS.—A vein is said to be varicose when it is the seat of permanent pathological dilatation. This condition is frequently met with in the spermatic and hæmorrhoidal veins. See VARICOCELE; HÆMORRHOIDS. Of other sites the lower limbs are by far the most frequent, although varix is occasionally found in the veins of the arm, of the neck and face, and also in the deep as well as the superficial veins of the trunk.

1. *Causes.*—The commonly accepted view of the etiology of varicose veins is that they are dependent upon increased intravenous pressure, or a deficient resisting power in the vein-walls, or upon these two conditions acting together. The increased intravenous pressure is usually attributed to one or other of three conditions: increased supply of blood to a part, obstruction to the outflow from a vein, and the influence of gravity. The active hyperæmia associated with chronic ulceration and other inflammatory processes, or with prolonged muscular contraction, throws a greater amount of blood into the veins of a part, and increases the pressure of the blood upon the venous walls. The influence of obstruction to the outflow from a vein is shown by the effects of the pressure of the pregnant uterus or other pelvic tumour upon the iliac veins; in women, the first occurrence of varicosity of the superficial veins of the leg is very often attributed to

pregnancy. A tight garter applied below the knee, and the pressure of a badly adjusted truss, are other examples of slight venous obstructions acting continuously, to which have been attributed the production of varicose veins in the lower extremities.

The column of blood in the arteries of the lower limb supports that in the veins, but the pressure of the blood upon the venous walls is increased by gravity, and is greatest, therefore, at the lower end of the column. When the valves are intact, the effect of gravity is annulled, but when, from injury, atrophy, or the dilatation of a vein, the valves are inefficient, the influence of gravity is fully felt. Deficiency in the tone or power of resistance of the vein-walls may be an inherited or a primary defect in their structure and function; or it may result from injury to the vein, inflammation of the outer coat of the vein, or from absorption of the tissues which usually support the veins externally. Probably, in some cases, varices are dependent upon obscure vital rather than upon simple physical causes, and the enlarged veins are to be regarded as hypertrophies or overgrowths of the veins, rather than as the results of the intravenous pressure and the tonic resistance of the venous walls.

Conditions to be specially noticed are heredity, age, sex, and occupation. In many cases there is found distinct evidence of the influence of heredity, varicose veins being seen in two or three generations of a family; where heredity is most marked, the varices generally appear early, and affect the larger superficial veins. Varicose veins most frequently begin to show themselves between the age of twenty and thirty-five, just when the frame is attaining to its full development and displaying its greatest activity. Varices are not infrequently met with earlier or later than this age; on the other hand, some cases improve after middle life. The disease is said to be more common in men than women; with the exception of pregnancy and the pressure of pelvic tumours, men are more exposed to the above-mentioned causes of varix, and to this the somewhat greater prevalence of the disease in them than in women is probably due. Any occupation which entails prolonged standing, such as that of a policeman, omnibus conductor, or of a washerwoman, both by the influence of gravity, and also by the powerful muscular contractions necessary to support the body in the erect position, is liable to cause varix. Any occupation entailing constant contractions of the muscles of the lower

limbs may have the same effect. A narrowing of the saphenous opening or of other apertures by which the superficial veins communicate with the deep veins has been alleged as a cause of varix, and a plan of treatment has been based upon this assumption. This view has, however, been entirely abandoned, especially since it has been shown that the venous dilatation affects the intermuscular and intramuscular veins as well as the subcutaneous vessels, and probably spreads from the former to the latter, while the superficial veins are specially prone to be dilated at the points where the deeper intermuscular veins communicate with them. A sudden severe strain, causing great distension of a vein, with or without rupture of a valve, may be the starting-point of a varix.

The effect of pregnancy upon the circulation in the lower limbs of women varies much. In many cases there is no interference whatever; in some cases there is some œdema of the feet and ankles in the later stages, without any apparent distension of the veins of the limbs; but in other cases the veins of one or other lower limb, or of both, or of the vulva, are considerably distended. This distension may come on quite early in the course of the pregnancy, before the uterine enlargement can be sufficient to account for it, and in these cases the varicose condition may not become worse in the later months of pregnancy. In other cases, the veins swell out only when the uterus has attained some considerable size, and may be supposed to exert considerable pressure upon the iliac veins. Not infrequently a woman will pass through her first pregnancy without any apparent distension of the veins of the legs, and yet suffer from it in subsequent pregnancies. The venous distension from pregnancy, when once it has occurred, is always repeated with any successive pregnancy; it may or may not persist in the intervals. Varicose veins may be met with in the healthy and robust, but are more common in persons with pale skin, flabby muscles and fibrous tissues, and of lymphatic temperament. The greater frequency of varix in the left than the right leg has been attributed to the pressure of a loaded sigmoid flexure upon the left iliac vein.

2. *Pathology.*—The disease is by no means limited to the superficial veins. It is very rare in the main deep veins of the limbs, except the posterior tibial, but it is common in the intermuscular and intramuscular veins of the lower limbs, and may

attack them before the subcutaneous vessels are dilated. The distribution of the affection in the subcutaneous veins also varies very much. In some cases, the whole length of the internal or external saphenous vein is enlarged, no other vessels being obviously affected; at other times, these large veins are dilated at a few isolated spots only; again, these trunks may be quite unaffected, and certain of their tributaries dilated to a size far in excess of the vessels into which they pour their blood. The small venules of the skin may be distended, or be quite normal; in many cases all these varieties of the disease are met with together. The superficial veins appear to be specially prone to varix just where the deep veins communicate with them, as if the vessel-walls yielded before the force of the double current of blood flowing into them. Varicose veins may be simply dilated transversely; more often they are elongated as well, and thrown into sinuous curves and coils, while, in the worst cases, the vein loses its cylindrical shape, and its walls are pouched out into aneurism-like dilatations.

Changes are usually met with in all the coats of a varicose vein: the inner coat is thickened, and, on slitting up the vessel, is seen to be thrown into longitudinal wrinkles; sometimes it is irregularly thickened (atheroma); or again it may be found to have undergone fatty degeneration and to have lost its transparency. The middle coat is commonly hypertrophied, the muscular tissue as well as the fibrous being in excess, but it may be thinned or absent altogether, especially over the saccular dilatations of a vein. The outer coat is less markedly thickened. Altogether, the venous walls are so notably thickened that, on section, the vein remains open like an artery. The valves are in places absent altogether, or they are found as delicate cords, sometimes adherent to the vein by one extremity only. The coils of a tortuous vein are united by firm fibrous bands, and similar bands unite the vessel to the overlying skin. The skin and subcutaneous fascia over a varix may be thickened, but more often they are gradually thinned; where a large varix lies over a bone, it may be hollowed out into a groove for the vessel. Thrombosis is liable to occur, and lead to the obliteration of the vein or the formation of a phlebolith. A more serious complication is a gradual thinning of the vein and of the skin over it, until it bursts.

3. *Symptoms and Diagnosis.*—An extreme degree of varix may be met with

without giving rise to any symptoms whatever. The worst case ever seen by the writer was in the leg of a man eighty years of age, in whom the whole length and circumference of the limb had been covered with very large tortuous veins for about sixty years; during the whole of this period there had been no pain or oedema, nor any symptom to trouble the patient. More often, varices are the seat of a dull aching pain or a sense of weight and fulness in the part, when from prolonged standing or walking, or any other condition, they become fully distended. Occasionally, when a vein presses upon a nerve, the pain is more acute, and is referred to the extremity of the nerve. The pain is quickly relieved by raising the part and lessening the fulness of the veins. Varix of a deep vein has been thought to explain the occurrence of cramp-like pains in a part. Varicose veins are often associated with simple oedema, chronic induration of the skin and subcutaneous tissue, eczema and chronic ulcers; but how far these conditions are directly dependent upon the dilated veins is open to question.

The *diagnosis* of superficial varix is quite easy: the enlarged vein is recognised by its tortuous cylindrical outline, its compressibility, the readiness with which it fills out again into a soft swelling when pressure is removed, and by its continuity with normal veins. When the varix is large and near the trunk, there may be a distinct expansile impulse on coughing. When the coverings are thin, the blue colour of the vein may be distinctly seen. This is especially the case when a venous pouch is about to burst. The varices vary greatly in size, extent, and distribution; they may be found at intervals along either saphena vein, or forming a close network of veins below either malleolus. A varix is often found crossing the front of the leg above the middle, or running over the front of the patella, or in the lower third of the front of the thigh. Varices of the small cutaneous veins appear as fine blue lines in the skin, generally grouped in a stellate manner. Rupture of a varicose vein may occur spontaneously or during some straining effort; the bleeding is rapid, blood flowing from each end of the vein. This accident generally happens to branches of the main veins, and particularly in the lower third of the leg; it may occur in the vulva. Deep varix may be diagnosed when the patient has dull or cramp-like pains in the leg on standing, which are at once relieved by lying down or raising the limb.

4. *Treatment* may be spoken of as palliative or curative, of which the former is the more generally applicable. Where varix has developed acutely after some sudden strain or prolonged exertion, the patient should rest in bed or on a couch for a month or six weeks, with the part evenly bandaged, and during this time the diet should be unstimulating and the action of the bowels carefully regulated. Subsequently, he should carry out the usual palliative treatment, which consists in affording external support to the veins and in preventing their undue distension. The external support may be afforded by well-fitting elastic stockings or by a carefully applied bandage. The stocking should not be too tight or too strong, and should fit the leg evenly; the bandage may be of cotton, thin flannel, or thin perforated pure rubber, and, when well applied, is often more comfortable than an elastic stocking. When any one vein is specially enlarged, it is a good plan to place a pad of corresponding size over it under the stocking or bandage. Where the venous enlargement is only slight, it is often sufficient for the patient to wear well-fitting silk or angola stockings, putting on a fresh pair each morning. Garters should not be worn at all, or only fastened round the thigh.

Venous engorgement should be prevented by avoiding prolonged standing, sudden straining efforts, or fatiguing exercises, these rules being enforced with a stringency in direct proportion to the acuteness of the disease, its tendency to increase and affect additional veins, and the distress it occasions to the patient. In the great majority of cases, walking and the various athletic exercises may be practised with advantage to a point short of fatigue or pain, especially if afterwards the leg be raised to a level with the hips. Applying to the part, after the cuticle has been removed by a blister, the solution of perchloride of iron, or the external use of the tincture of witch-hazel has been recommended, but the writer is unable to advocate either measure from his personal experience. Constipation is to be carefully avoided. Where the patient is anæmic, the astringent preparations of iron should be administered internally.

When varicose veins arise during pregnancy, the patient should wear a bandage on the legs, and rest as much as possible in the horizontal position, and, after her confinement, she should still continue to wear the bandage for some weeks.

When a vein is threatening to burst, the part should be carefully bandaged and kept

horizontal. When a varix has ruptured externally, the bleeding may be easily controlled by raising the limb; a pad of lint should then be firmly bandaged over the wound, and the leg kept at rest for a week until the scar is sound.

Many modes of obtaining the radical cure of varicose veins have been suggested and practised, only some of which need be mentioned.

1. *Acupressure*.—A flat needle, preferably with a curved point, should be passed beneath the vein, and a piece of quill or gum bougie be laid over the vein, and held firmly in place by silk twisted over the ends of the needle in a figure of eight. Two pins may be placed near together, and the vein divided subcutaneously between them. If, on introducing the needle, venous blood escape, its point should be withdrawn and passed in deeper at a closely adjacent spot. The pins should be withdrawn in about a week, but this time may be shortened or lengthened if the reaction in the part is excessive or too slight. The pins must not be passed where the skin is inflamed. This method often fails to obliterate the veins.

2. *Ligature*.—An incision just long enough to expose the vein is made through the skin and cellular tissue, and through it, by means of an aneurism needle, carbolised silk or chromic acid catgut is passed around the vein and tied. The ligature is generally applied in several places; it may be used as a double ligature, and the vein be divided between. It obliterates the vein safely and certainly; the extent of the vessel obliterated at each ligature is usually only small.

3. *Excision*.—An incision is made over some length of a varix, and carried down so as to expose the vein. A double ligature is then tied around one end of the vessel, and the latter is divided between and raised from its bed; each branch entering the varix and its lower end are similarly divided between double ligatures, and the edges of the skin-wound are united by sutures. This operation is more formidable than the others, but completely removes the disease.

The external application of caustics or the intravenous injection of coagulants is not to be recommended.

In view of the implication of the deep veins in varicose disease, the radical cure of superficial varices is not generally advisable, and when practised is often disappointing. The cases most suitable for it are those in which there are only one or two veins affected, or in which some one or two varices are the cause of special in-

convenience or suffering. Where a patient is disabled by the disease, and this is limited to one or a few parts only, the radical cure should be attempted, and the younger and more healthy in other respects the patient, the greater the desirability of the operation. As a rule, to which there are few exceptions, chronic oedema or induration or ulceration of the skin and subcutaneous tissues is a bar to operation; but where a varix can be traced down to an ulcer, obliteration of the vein is sometimes the best means of curing the ulcer. Where the varix to be treated consists of an isolated 'bunch of veins,' excision is the best operation. Where it is desired to obtain the obliteration of a number of varices or of several parts of one long dilated vein, the application of the ligature or of acupressure is the best means to adopt, and of these the ligature is preferable. Ligature and excision should be performed with careful antiseptic precautions. The dangers of spreading phlebitis and of embolism must be kept in view in the after-treatment. A. PEARCE GOULD.

VARIX OF LYMPHATICS. See LYMPHANGIECTASIS.

VEGETATIONS, Adenoid. See NASO-PHARYNGEAL GROWTHS.

VEGETATIONS, Syphilitic. See SYPHILIS.

VEINS, Air in. See AIR IN VEINS.

VEINS, Diseases of. See PHLEBITIS; THROMBOSIS.

VENESECTION, the operation of opening a vein for the purpose of general blood-letting. One of the vessels at the bend of the elbow is commonly chosen, but if these should be too small or from any reason unsuitable, the external jugular vein at the root of the neck or the internal saphena above the ankle may be utilised.

Apparatus required.—Lancet or small double-edged scalpel, bandage, tape, pad of lint, bleeding basin, sponge and water.

Operation.—I. *At bend of Elbow.*—The patient being in the recumbent or sitting position, with the limb extended and supinated, a piece of tape should be tied around the upper arm at about its middle, sufficiently tightly to obstruct the venous circulation without interfering with the pulse. The veins having become swollen, the median cephalic or median basilic, whichever happens to be the larger, is selected; if they are of equal size the median cephalic is preferable, in consequence of the extreme

proximity of the median basilic to the brachial artery.

The elbow having been grasped in the operator's left hand, the vein is fixed by placing the thumb on it just below the site of the proposed opening. The lancet-blade, held between the finger and thumb of the right hand, is then passed into the vessel until the blood flows by its side, the blade is carried onwards, horizontally, for about one-third of an inch and made to cut its way out so that the wound in the skin shall be larger than that in the vein. The pressure of the thumb is then removed, and the blood allowed to flow into the bleeding-bowl until the required amount has been taken. If the stream be sluggish, the patient should hold a stick or rolled bandage in the hand, and grasp it firmly at frequent intervals.

To arrest the bleeding, the constriction around the arm must be removed, a pad placed on the wound and retained in position by a figure-of-eight bandage or tape. For two or three days the arm should be carried in a sling; at the end of the fourth day, by which time the wound has, as a rule, healed, the pad and bandage may be dispensed with.

In opening the vein, it is of the utmost importance to avoid cutting too deeply, otherwise the posterior wall of the vessel may be laid open, a mishap which sometimes proves serious in the case of the median basilic vein, when the brachial artery is likely to be wounded and a varicose aneurism or aneurismal varix to follow. Care must also be taken to prevent the skin from gliding over the opening in the vein and so forming a valve-like wound, which is apt to impede the flow of blood and lead to subcutaneous extravasation.

II. *At root of Neck, Venesection of External Jugular.*—The patient being, if possible, in the reclining position with a pillow under the shoulders, and the head turned to the side opposite that selected for the operation, a small cork or hard pad of lint should be placed on the vein, as it dips under the clavicle at the outer border of the sterno-mastoid muscle, and held firmly in position by the thumb, or, more conveniently, by a bandage passing beneath the opposite axilla. The vein should then be opened in the manner already described, as it lies on the surface of the sterno-mastoid, the incision being made in the direction of the fibres of that muscle—i.e. transversely to the fibres of the platysma. The blood may be caught in a shallow receiver, or conducted into a bleeding-basin by means

of a small funnel or a channel made of paper or cardboard.

To arrest the bleeding, a compress should be placed on the wound and held in position by the thumb until the pad above the clavicle has been removed, when it may be firmly strapped in its place. Much care is necessary in the adjustment of the clavicular pad, as its great object, in addition to obstructing the circulation, is to obviate the possibility of air passing down the vein, which is the main risk in this operation; for the same reason it should on no account be disturbed until the opening in the vein has been closed.

III. *Above Ankle.*—*Venesection of Internal Saphena.*—A method rarely practised in this country. A tape having been tied around the leg just below the calf to obstruct the circulation in the vein, the operation is performed in the same way, step by step, as that described at the bend of the elbow. To increase the flow, should it be sluggish, the foot may be continually rubbed in an upward direction or held in warm water. WILLIAM H. BENNETT.

VENOMOUS SERPENTS, Bites of.—

The poison is secreted by a gland situated behind the eye and beneath the masseter muscle; thence the fluid is conveyed through a curved duct to the base of the fang, and by a channel traversing this tooth, or by a groove in its posterior surface, the secretion is discharged. The upper fangs alone admitting the venom, it is important always to estimate in any case the size, position, and number of the punctures.

Poisonous serpents abound in India, America, Africa, and Australia, and in England there is one—the adder. The best known are the Indian cobra, the American rattlesnake, and the Australian tiger, black, brown, and copperhead snakes. The general effect of the poisons of all these is very similar, and it is probable that the essential lethal element is the same, while certain peculiarities give different local effects.

The Venom.—The secretion of the poison-glands seems to be in all venomous reptiles essentially the same in appearance. Thus, Prince Bonaparte described that of the viper as 'having a gummy appearance, somewhat resembling uncoloured varnish, perfectly clear and transparent;' while Halford says of the venom of the black snake of Australia that it is a 'faintly yellowish pellucid fluid, ranging in consistence from thin syrup to thick gum-water, and upon exposure rapidly thickens, and becomes like

hard gum.' Fayrer describes the cobra-venom as a 'clear, slightly viscid fluid, soluble in water, and slightly acid.' It will keep months or years between slips of glass and still retain its virulence, and even after the heads have been long in spirit the poison retains its power.

The effects of the venom are the same in all the most deadly snakes. There seems no limit to the amount that may be taken harmlessly into the stomach, nor does it matter whether the animal be fasting or not. This explains the freedom from poisoning after sucking a wound; but here it must be pointed out that, as the poison may be absorbed through an abrasion, great care is necessary. While the mucous membrane denies a passage to the poison, the synovial membranes allow it to pass rapidly into the system. It is stated by Fayrer that the flesh of animals killed by the venom is not poisonous, and is eaten by the natives. The coagulating power of the blood seems to be destroyed in nearly all cases, and this is shown, not only by its fluid condition after death, but by the free bleeding from the wound, the ecchymosis, the hæmoptysis, and the escape of blood in the stools.

Mitchell observed that when rattle-snake poison was applied directly to the mesentery, rupture of the small vessels occurred, an effect going far to explain the hæmorrhages. Extravasations are found in the serous membranes. Rigor mortis is said always to be present.

Symptoms.—In England, the bite of the adder sometimes gives rise to serious symptoms. Several cases are recorded in the journals from which, and from a case seen by the writer, this account is drawn. Locally, pain is immediately felt—acute and burning—and is rapidly succeeded by swelling. The punctures are very fine and appear as two discoloured points. In one class of cases the part swells rapidly, the skin retaining its natural hue. The swelling extends up the forearm and arm, over the shoulder, down the side of the chest, over the back, and may reach the abdomen and groin, and with all this there may be no discoloration, no pain, no glandular enlargement, and few, if any, constitutional symptoms after the first few hours. Gradually the swelling subsides, leaving the arm unaffected. This form of swelling is peculiar, and does not correspond with any of the common affections, and seems special to this poison. In other cases, however, lividity and ecchymoses accompany the swelling, or even a diffuse cellular inflam-

mation may occur, as in a case recorded by Mr. O. Pemberton.

The general symptoms appear quickly, faintness, sickness, and diarrhoea being the earliest and most constant. The pulse is quick, feeble, and may become imperceptible. Dyspnoea also is common. Some complain of intense epigastric pain, and in one case mucus and blood appeared in the stools. The removal of a ligature in one case produced sudden fainting, and it was a week before the patient recovered. Again, in others there may be few or no general symptoms.

Weir Mitchell says that the bite of the rattlesnake is sometimes followed by pain of a pricking or burning character, which gradually becomes intense. Blood flows freely from the punctures, and the parts around swell and become discoloured from extravasation of blood. The wounded extremity becomes larger and the pain greater, the skin assuming a mottled, marbled aspect. A phlegmonous inflammation follows in some cases as a secondary effect, associated with glandular enlargement, suppuration and even gangrene, great depression of the nervous system and general prostration with profuse sweats, vomiting, dyspnoea and diarrhoea. Five and a half hours he gives as the shortest period in which death occurred.

After the cobra-bite death may occur very quickly, with prostration and other symptoms like rattlesnake-poisoning. Fayrer gives one case in which death occurred in half an hour; others lasted two, ten, and twenty-four hours, and one as long as eight days.

Halford says of the bites of the snakes of Victoria that the commonest effects are vomiting, dilated pupils, feeble and intermittent pulse, followed by lethargy and coma. In other cases consciousness is very slightly or not at all impaired, and there are muscular spasms, chiefly of the neck, and tenesmus. These latter are the more serious.

Treatment.—The leading authorities—Weir Mitchell, Halford, and Fayrer—on snake-poisons agree that the mortality of fang-wounds has been greatly exaggerated, for many are inflicted by non-poisonous serpents, and, as much depends upon the condition of the reptile at the time, a poisonous snake does not always give a fatal bite. It is from neglecting such points as these that so many innocent substances, as olive oil, snake root, ammonia, salt, &c., have obtained an undeserved reputation. No doubt the great drawback to successful treatment is the delay caused, in many in-

stances, by the distance of the victim from efficient help, and, amongst natives, to their preference for the charms and incantations of their medicine-men. There is again the great confusion attending the occurrence, its suddenness, the rapid gliding away of the serpent, the doubt as to whether it was poisonous or not, and the intense mental dread of impending death and the shock consequent thereon. The native methods also of beating the victim with sticks, walking him about, and keeping him awake by loud noises, tend to increase the exhaustion, while, on the other hand, amongst more civilised communities, the custom of administering large quantities of brandy or other spirit, produces a variety of symptoms, in which it is difficult to say how much is due to the remedy and how much to the poison. Therefore it is that all writers with a practical acquaintance advise a more deliberate use of remedies, and a careful estimation beforehand of the amount of venom probably introduced. Whatever the kind of snake, whether Indian, American, or Australian, one treatment is applicable in all cases. The following summary is drawn from the writers named. It must be here remarked that in the case of the English adder, immediate ligature with incision, sucking or cupping, followed by the 'relaying' of the constricting band, is sufficient local treatment.

In all cases, where possible apply a ligature tightly above the wound, and one or two others higher up the limb, at intervals of a few inches. Tighten that nearest the wound by twisting with a stick, as it requires a great deal of pressure to prevent absorption.

Now consider the case; determine if possible whether or not the snake was poisonous, whether a large dose of poison is likely to have been introduced or not; examine the number of fang-wounds. We may by such inquiries be enabled to reassure the patient, and allay the mental dread, or obtain sufficient data for extreme measures.

In all cases freely excise the part, taking away the subcutaneous connective tissue, and apply to the raw surface strong carbolic acid, the cautery, or a mineral acid; or, before this is done, let the wound be sucked by the patient if possible, or by someone not unwilling to incur a slight amount of risk. Instead of this a cupping-glass may be applied.

If the snake be a deadly one, or if the dose of poison be large, amputate at once above the wounded part.

Now await the onset of symptoms, keeping the patient quiet; if they appear, give stimulants gradually to restore the force of the heart. Should the patient recover the first absorption of the poison, loosen the highest ligature and wait for the renewal of the symptoms, and when these appear, reapply the ligature, and administer the stimulants. Repeat this method of 'relaying' the ligature, finally removing it altogether, for the parts beyond are sure to suffer if deprived too long of their blood. The sudden removal of a ligature, in the case of an adder-bite, produced fainting in a lad showing no symptoms up to that time. By admitting the poison which must necessarily enter the circulation in this intermittent way, the patient may be able to survive the effect of small doses. 'There is reason to believe,' says Halford, 'that, if applied without delay, a ligature may stay the course of the poison and life be saved.' Unfortunately, it is neither applied quickly nor tightly enough, owing to the ignorance of those most commonly bitten.

If a ligature cannot be applied, the part must be at once freely excised, and the blood removed by sucking or by a cupping-glass, and then the wound freely cauterised. A live coal is often used for this purpose.

The general symptoms must be met as before by stimulants, hot bottles, sinapisms and galvanism.

The intravenous injection of ammonia was introduced by Professor Halford in poisoning by Australian snakes, and the cases he records leave no doubt as to the efficiency of the remedy under some circumstances; and when it is remembered that Halford himself states that the venom of the cobra and crotalus (rattlesnake) is identical in action with that of the Australian snakes, it is disappointing to find that a like success has not attended the use of the remedy in the hands of Indian and American physicians. The number of cases in which ammonia has been employed is sufficient to prove that no harm has resulted from its use, and therefore this fear need not deter others. The *liquor ammoniæ fortior* is used, mixed with distilled water. The following proportions are taken from Halford's cases: ten minims to twenty of water restored consciousness; twelve to a drachm of water restored a man whose pulse was feeble and intermittent, and whose pupils were fixed and dilated; fifteen with five of water, and again in the same case twenty minims with five of water were injected twice, while in

another case one and a half drachms in all were used.

Permanganate of potash has recently been recommended, but has, with liquor potassæ, been found of no value by the majority of observers, so that at present we have no specific against snake-bite.

CHARTERS JAMES SYMONDS.

VERRUCA. See WARTS.

VERTEBRAL ARTERY, Ligature of the.—This artery was first tied by Dr. Smith, of New Orleans, on May 9, 1864, as an adjunct in the surgical treatment of an innominate aneurism. In 1879 and following years the writer performed the operation on thirty-six cases of epilepsy. After the first case he mostly tied both arteries simultaneously. He also performed the same operation on two cases of infantile paralysis, two cases of locomotor ataxy, and one case of chorea.

The operation is best performed in the following manner:—An incision, three to four inches long, is made in an upward and outward direction along the hollow which exists between the scalenus anticus and the sternomastoid muscle. The incision should begin just outside and on a level with the point where the external jugular vein dips over the edge of the sternomastoid muscle, or if the vein is invisible, about half an inch above the clavicle. The external jugular vein is to be drawn inwards with the sternomastoid muscle. The connective tissue now appearing in the wound is opened up by a blunt director until the scalenus anticus muscle, the phrenic nerve, and the transverse cervical artery are seen. It cannot be too well remembered that the pleura is at the inner side of the wound, whilst below lies the subclavian artery. It is now only necessary to separate the edges of the scalenus anticus and the longus colli muscles to see the vertebral artery lying in the space between them. The artery is generally covered completely by its vein, and the latter has to be drawn aside previous to ligature. Some surgeons look for the prominent transverse process of the seventh cervical vertebra, and this is a good landmark.

Should the artery enter the vertebral foramina higher than usual, the vessel must be looked for to the inner side of its usual course. The overlying vein may be drawn outwards or inwards. Generally the first is more convenient, and may be easily managed by means of an aneurism-needle. Another needle is now passed from without inwards behind the artery, its eye threaded with catgut, and the needle

withdrawn, carrying the ligature. The vein is then to be released, and the ligature tied and cut off short in the usual way. The wound is now to be sponged out with boracic or other lotions, a drainage-tube inserted, and dressings—either strictly or modified antiseptic ones—applied. If the operation is performed with suitable retractors and a good light, the proceeding is a very easy one, and without both it is well-nigh impossible. It is also safe, as no important structure need be at all interfered with.

It has been recommended to tie the artery by coming down upon it directly from the surface, but it is better not to describe that method here. It is only a dissecting-room operation, in which interference with the pleura and the subclavian branches and large veins does not signify much, and cannot compare practically with the easy, safe, and natural operation already described.

Value of the operation in Epilepsy.—It was performed by the writer in the hope that a lessened supply of blood to the hinder brain and spinal cord would result in a diminution or cessation of the epileptic convulsions. On most theories of epilepsy the expectation was a very reasonable one; because it was hoped that the diminution would be more permanent to the parts supplied after ligature of the vertebrals than after ligature of other vessels, on account of the absence of anastomosing branches, and the restraints to dilatation of the unligatured vessels by the bony canals through which the cerebral vessels pass, as the experiments of Sir Astley Cooper on dogs tended to prove. For a time these expectations were realised, but soon relapses occurred, and in May 1884 an analysis of thirty-six cases of operation for epilepsy showed only eight cases which have had so few fits since operation that they may be practically considered cures. Eleven were for several months so much improved that they seemed to be cured; and, although the fits have recurred in all, yet the improvement is still distinctly manifest in many. In sixteen cases there did not seem to be any decided improvement, either of a temporary or permanent kind. Three died out of the thirty-six, one from hæmorrhage, one from embolism, and one from pleurisy. All the cases operated on were chronic, hopeless epileptics, many of whom had gradually become mentally affected. None of the latter were permanently benefited to any practical extent. Of the others the best case was an idiot boy, now in the Albert Asylum, Lancaster, and the next best a perfectly sensible, healthy lad. In two

cases of traumatic epilepsy, one was cured and the other much benefited. It is impossible, therefore, to say, before operating, what cases would probably derive benefit from the operation and what would not.

On account of this uncertainty, the writer has ceased to recommend or perform the operation for the last two years. Of the cases of infantile paralysis, one patient was completely and rapidly cured, the other was unaffected. Great temporary advantage occurred in one case of locomotor ataxy. The pains and ataxy rapidly diminished for a time; the other case remained unaffected. The case of chorea ceased to twitch, until hæmorrhage from a small vein set in, that, allowed to pass unnoticed, ended in death. The twitching reappeared after the hæmorrhage. As far as the writer can at present see, this chapter of surgery may be closed.

WM. ALEXANDER.

VESICO-INTESTINAL FISTULA.

A communication between the interior of some part of the intestine and that of the bladder. The congenital form of this condition and those which result from injury or disease of the rectum have been described under ATRESIA ANI; Injuries and Diseases of the RECTUM.

Vesico-intestinal fistula may also result from wounds or malignant disease of the bladder, or from suppurative inflammation of the intestine, bladder, or adjacent structures. Adhesion of the intestine to the bladder, directly or indirectly, is essential for the formation of the fistula. The channel may be short or long, direct or tortuous, narrow or wide. In some cases, it passes obliquely through the walls of the intestine or bladder so as to render the aperture valvular, and thus resembles the connection of the ureters with the bladder. The intestinal aperture may be in the rectum, the sigmoid flexure, the vermiform appendix, the cæcum, or the small intestine. The vesical aperture may be on any surface of the bladder. Of these varieties the recto-vesical form occurs most frequently. In vesico-intestinal fistulæ, of traumatic or malignant origin, the intestinal aperture is almost invariably in the rectum or sigmoid flexure. Of eighteen cases, not of traumatic or malignant origin, collected by Blanquinque, nine opened into the rectum, four into the sigmoid flexure, two into the vermiform appendix, one into the cæcum, and two into the small intestine.

Traumatic vesico-intestinal fistulæ may be caused by gunshot or other penetrating wounds from without, or by perforation of

the bladder or rectum by foreign bodies introduced through the urethra or anus. Non-traumatic fistulæ most frequently result from necrosis of malignant growths involving both rectum and bladder. Fistulæ of suppurative origin may result from typhoid ulceration of the small intestine, typhlitis, perityphlitis, perforation of the vermiform appendix by impacted foreign bodies, or from ulceration caused by simple or syphilitic stricture of the rectum or sigmoid flexure. When the fistula originates in the bladder, chronic cystitis, especially when associated with a sacculated condition of the bladder, appears in some cases to have been the exciting cause. Suppuration or tuberculosis of the prostate gland may result in a recto-vesical fistula. Pelvic abscesses may also open into both intestine and bladder, and so produce a fistulous channel interrupted by the abscess-cavity.

The *symptoms* of vesico-intestinal fistula vary in different cases. Usually, the attention of the patient is first attracted by the passage of gas from the bladder towards the end of micturition with a sound—compared, by those who have had an opportunity of hearing it, to that produced by the passage of the last portion of fluid from a soda-water siphon. If the fistula be narrow, this may be the only symptom, and may only occur occasionally. The intermissions are, probably, due to blocking of one or other aperture of the fistula by inflammatory swelling of the mucous membrane of the bladder or intestine. If the channel be wider, urine may pass into the intestine, or some of the solid contents of the intestine into the bladder. In recto-vesical fistula, the passage of urine by the anus cannot fail to attract the attention of the patient. In other forms the diarrhoea, which would probably result from the irritation of the mucous membrane of the bowel by contact with urine, would mask this symptom. Any solid matter passed from the bladder should be examined microscopically for the undigested residue of animal or vegetable food, and chemical tests for the bile-acids might also be applied. The bladder is in some cases very tolerant of these foreign substances; in other cases they excite severe cystitis, and always endanger the formation of calculi and retention from the possible occlusion of the vesical orifice.

The *diagnosis* of vesico-intestinal fistula is usually not difficult. The passage of gas from the bladder at the end of micturition is almost pathognomonic. In recto-urethral fistula, gas may also pass from the urethra; but this may occur at any time, and not

necessarily during micturition. In vesico-intestinal fistula it is always towards the end of micturition. Gas is said to be sometimes generated in the bladder from decomposition, in rare cases of acute cystitis; but in such cases a speedily fatal result would terminate all doubt. The passage of urine by the anus, or of solid intestinal contents by the urethra, could leave no doubt of the nature of the case. Sometimes, the diagnosis is aided by the urine, passed normally from the bladder, being coloured by the drugs employed to check the diarrhoea. There is very great difficulty in localising the intestinal aperture, if this be beyond the reach of digital or ocular examination. The injection of coloured fluids into the bladder or the rectum has been suggested as a possible aid, but in some cases the requisite force might produce dangerous consequences, and in others a valvular aperture to the fistula, or the intervention of an abscess-cavity in its course, might render the experiment fallacious. Careful bi-manual examination of the pelvis and minute inquiry into the previous history might give some indications; but there must always be uncertainty as to the position of the intestinal aperture in non-malignant fistulæ, when the aperture is higher up than the rectum.

The *treatment* must vary with the nature of the case. When the fistula has supervened on malignant disease, lumbar colotomy will, if the condition of the patient allow of the operation, afford great relief by diverting the course of the fæces. In two cases of non-malignant fistula, this operation was performed by Pennell and Holmes with very satisfactory results. This procedure can only be adopted, when there is reasonable probability that the artificial anus will be above the intestinal aperture of the fistula. In one case of non-malignant fistula, where the channel was probably narrow, permanent occlusion was effected by the constant retention of a catheter for six weeks, the bladder being thus kept in a contracted condition. In similar cases, if the catheter should cause irritation, a temporary perineal fistula would probably be of service. If the case be complicated by a vesical calculus, this should be removed by lithotomy or lithotripsy; but if the fistula has resulted from chronic cystitis, the condition of the kidneys might contra-indicate any operation. When more active treatment is impossible, careful irrigation of the bladder and attention to cleanliness and diet will give some relief.

JEREMIAH MCCARTHY.

VESICO-VAGINAL FISTULA. See VAGINAL FISTULÆ.

VESICULÆ SEMINALES.—The diseases of the seminal vesicles have received but slight attention, and little is known concerning them. These organs may be the seat of acute, subacute, or chronic inflammation, and the acute form of the disease may run on to suppuration, the abscess bursting into the bladder or the peritoneal cavity. Chronic inflammation may cause obliteration of the common ejaculatory ducts. The vesicles may be dilated into cystic swellings opening into the urethra, or closed cysts attaining a large size may develop in connection with them. Small spermatic concretions, or larger calculi, may form, and lodge in the vesicles. Lastly, they may be the seat of strumous or of cancerous disease. The vesicles can be easily explored from the rectum, and the diagnosis of their affections mainly rests upon the results of a rectal examination.

1. *Inflammation.*—The most common cause of inflammation is gonorrhœa; other causes are venereal excesses, masturbation, caustic urethral injections, and prostatitis. When *acute*, there is general febrile disturbance, severe pain felt in the groin, hip, and round to the loin of the same side, frequent painful micturition, and the finger in the rectum detects a tender firm swelling just beyond the prostate. Should *suppuration* occur, there may be a rigor, the swelling is increased, and fluctuation may be detected in it when suprapubic pressure is made. *Subacute* and *chronic* inflammation are characterised by local pain and tenderness, frequent micturition, frequent painful erections, the presence of spermatozoa in the urine, a gleet discharge, and excessive nocturnal pollutions, the semen being discoloured red or brown; in some cases similar emissions occur during defæcation.

Treatment.—In the acute form, rest in bed, hot hip-baths, a brisk saline purge, slop diet, and opium and belladonna suppositories. As soon as fluctuation can be detected, the abscess should be opened through the rectum. The treatment of chronic inflammation is unsatisfactory; sexual excitement and constipation must be avoided; tonics, such as quinine and iron, may be useful; but a cure can only be hoped for after a period of many weeks or months.

2. *Cysts.*—These rare tumours may cause difficulty in defæcation and frequency of micturition. They displace the bladder upwards and for, ards, fill the pelvis, and then

rise into the belly. The diagnosis is made by noticing the position of the tumour between the rectum and bladder, by finding, when a catheter is introduced into the bladder, that that viscus is empty and stretched over the front of the swelling, and by detecting fluctuation in the mass. The only appropriate treatment is to tap the tumour, with a trocar and canula, through the rectum. Should this, when repeated, fail to cure the case, it would be right to inject iodine into the cyst, as in the case of a vaginal hydrocele.

3. *Tubercular Disease* of the seminal vesicles is only known as occurring secondarily to tubercular inflammation of the testicles, prostate, or bladder. The pathological changes are similar to those in the testicle. There are no special symptoms distinguishing this affection, and it can only be recognised by detecting the nodular and slightly tender mass of the enlarged vesicle lying between the rectum and bladder behind the prostate. Owing to the frequency of this complication, and the ease with which it can be recognised by rectal examination, it should be sought for in all cases of tubercular disease of the testicle. The only suitable treatment is the constitutional treatment mentioned under *Tubercular Disease of the Testis*. See TESTIS, Diseases of the. Should any part of the infiltrated vesicle fluctuate, it might be opened through the rectum.

A. PEARCE GOULD.

VIBRIO is a small organism, one of the SCHIZOMYCETES, the form of which is that of a curved bacillus. The curves may be one to two in number.

Vibrios are found in stagnant water, in the fluids of the mouth, and recently in considerable quantities in the small intestine in cholera.

Vibrio cholerae, also called the 'comma bacillus' (Koch), is an organism which behaves in its mode of growth, in both solid and liquid cultures, just as a putrefactive organism; it liquefies gelatine, forming a deep well in the substance, and when grown in liquids it forms a scum which afterwards sinks.

In form it exhibits various shapes between the simple curved rod and a spiral (?) figure, produced by segmentation without separation of the individual organisms. Experimental inoculation on the lower animals has, so far, been productive of results of only doubtful value, so that it cannot be said to have been proved to possess specific properties; and moreover, Klein has shown that in fulminating cases often only

a few 'commas' are to be found, and those only in the mucous flakes of the bowel. The two views held at the present time are those of Koch and Klein respectively; the former believing that the comma organism is the cause of cholera, the latter regarding it simply as a consequence of the disease. In the absence of more accurate experimental evidence than we at present possess, no positive decision can be expressed on this point.

VICTOR HORSLEY.

VILLOUS TUMOURS are so called from the resemblance which they present to the villi of the chorion. They grow in the bladder, breast, cerebral ventricles, intestine, larynx, rectum, and stomach. Formerly, all such tumours were looked upon as malignant, but pathologists of the present time class them under the two main groups of non-malignant papillomata and malignant sarcomata and carcinomata.

The *Non-malignant or Papillomatous* forms are found in the bladder, rectum, and larynx. They consist of branched outgrowths from the mucous membrane of these parts. Each outgrowth is composed of connective tissue covered with a layer of tessellated or cylindrical epithelium, which readily separates when the tumour is macerated. In the centre of the outgrowth are an arteriole and venule, which communicate by a peripheral loop of capillaries. The capillaries are often dilated into small botryoidal appendages. The main papilla gives off secondary and these again tertiary papillæ, which are identical in structure with the parent stem. In this way we find long filiform processes arising from a small circumscribed base, such as have been described under **BLADDER, Tumours** of the. The villous tumours of the stomach are less complex than those just described, inasmuch as they consist of simple papillæ without secondary offshoots.

The villous papillomata undergo various forms of degeneration: thus, they may ulcerate or the delicate capillaries may rupture, and the blood escaping into the villi may be converted into pigment. On the other hand, the vessels may become calcified, or the villous tumour may become encrusted with a phosphatic deposit; the latter degeneration is especially liable to occur in the bladder, where the fringes float in the urine. The investing cells in some cases undergo colloid degeneration.

The *Malignant Villous Tumours* are either sarcomata or carcinomata. It is now recognised that a non-malignant or papillomatous growth may, in course of

time, become converted into a malignant growth of similar microscopic appearance. The chief obvious difference between these two classes of tumours is that, in the non-malignant papillomatous growth, the epithelium is situated only upon the surface of the papillæ, and is therefore homologous, whilst, in the malignant varieties, the cells are found as well within as without the connective-tissue basis of the papillæ, and they are therefore heterologous.

The malignant villous tumours are either sarcomata or carcinomata of an epithelial or adenoid type.

The *Villous Sarcomata* are said by Billroth to grow from serous membranes, the cellular elements consisting of enlarged cells derived from endothelium, the stroma being formed of connective tissue. They are found growing from the membranes of the brain and from their nerve-sheath prolongations.

The *Villous Carcinomata* are either epithelial or adenoid in type. They grow most frequently from the stomach and urinary bladder, though they are occasionally found in other parts.

Epithelioma of the bladder occurs as a warty or villous excrescence of the mucous membrane, having the usual character of an epithelioma. The growth commences in the mucous membrane, and is covered with tessellated epithelium. It is recognised by its invasion of the submucous and muscular coats.

Villous cancer or duct cancer is a rare form of carcinoma occurring in the breast. It is described by Cornil and Ranvier as a tubular epithelioma, and by Rindfleisch as a cysto-sarcoma (fibrous or mucous). It is a malignant growth springing from the galactophorous ducts. The new growth obstructs these ducts, thereby converting them into cysts. Processes of fibrous tissue covered with columnar epithelium and containing blood-vessels, which may rupture, grow into these cysts. The growth has the appearance of an encephaloid cancer. A similar villous cancer may develop from the sweat or other simple tubular glands, such as those of the neck of the uterus and the soft palate.

Columnar epitheliomata grow from the glands of the large intestine, and cylindrical epitheliomata from the brain and orbit.

Villous growths of an innocent nature occur on the synovial fringes of bone in osteo-arthritis as the result of simple hypertrophy, and as granulations from the choroid plexus and Pacchionian bodies.

D'ARCY POWER.

VISION, Disorders of, from injuries of the head and spine.—The vision of one eye or of both may be impaired or destroyed, temporarily or permanently, by injuries to the head, even when the eye itself is absolutely unharmed. The commonest perhaps amongst these are fractures of the base of the skull, where the line of fracture runs through some part of the anterior fossa, in the neighbourhood of the optic foramen or of the lesser wing of the sphenoid. Cases of this kind are very often fatal, and it has been clearly established by Hölder and others, who have directed their attention to the state of the optic nerve in such injuries, that the sheaths of the optic nerve, subdural and sub-arachnoidal, one or both, are frequently distended with blood. This observation throws light on the cases where a patient discovers, on regaining consciousness after severe head-injury, that he has completely lost the sight of one eye—on the side, that is, where the line of fracture runs.

The blindness is, probably, due to pressure on the optic nerve by blood within its sheath, a view supported by the fact that no changes or signs of injury can be found in the eye itself, and that vision sometimes undergoes improvement, or even, it may be, restoration, as the blood is gradually absorbed. The result, in all probability, depends upon the amount of blood which has been extravasated, and on the state of the neighbouring circulation, matters on which, clearly, no opinion can be expressed in individual cases. If the amount of blood extravasated be large, it is not only unlikely that it will be altogether absorbed, but there is also a risk that, from its continuous pressure, some interference may take place with the nutrition of the optic nerve itself, and the ophthalmoscope may in course of time reveal signs of atrophic or other changes in the optic papilla. Whether treatment of any kind can be of any avail, in such cases, is extremely doubtful. The prognosis can only be unfavourable when absolute blindness dates from the moment of the accident, and consolation must be sought in the fact that one eye only has been affected, a circumstance dependent on the usual obliquity of the line of fracture, which thus involves only one optic foramen. *See* OPTIC NERVE, Diseases and Injuries of the.

Cases, moreover, may be met with in which, as the immediate result of severe injury to the head, there is impairment of vision of both eyes. Here it seems probable that the line of fracture, or seat of injury

to nervous structures, lies posterior to the optic foramina, and involves the region of the optic chiasma or tracts. A careful examination of the fields of vision is essential, in such cases, to determine the seat of injury, whether it be in the optic nerve, which contains all the fibres going to the retina of its own side, or in the optic tract which contains the fibres running to the temporal half of the retina on its own side and the nasal half on the opposite. The phenomenon of homonymous hemianopia may therefore be an important diagnostic and prognostic symptom; for there seems to be a better chance of restoration of sight when the extravasated blood lies at the base of the brain, than when it is confined within the optic sheaths, from the fact that absorption can in all probability be more easily and speedily accomplished in that situation. *See* PERIMETRY.

The *prognosis* in all such cases, however, is bad, whether the loss of vision affects one or both eyes, and when the history of the injury warrants a belief that there is fracture of the base of the skull or some severe injury to the brain. To aid this diagnosis the surgeon must look for other signs and symptoms, bleeding from and deafness of one ear, subconjunctival extravasation of blood for example, and paralysis of special nerves. Yet, every such sign or symptom may be wanting, even in cases of severest injury; and the absence likewise of any evidence of damage to the eyeball itself, after careful ophthalmoscopic examination, may be the only clue, and that merely negative, that the loss of sight is probably due to the causes above-named.

As far, therefore, as pathological knowledge at present enables us to affirm, immediate one-sided blindness, after severe head-injury, is probably due to hæmorrhage within the sheath of the optic nerve, associated, in a large percentage of cases, with, or caused by, fracture passing near or through the optic foramen; whereas double blindness, complete or partial, is in the same circumstances probably due to basal hæmorrhage, with or without fracture in the middle fossa of the skull, which presses upon the optic chiasma or tracts. And yet hæmorrhage within the sheaths of one optic nerve is by no means invariably associated with fracture of the base, for cases are on record in which hæmorrhage in this situation has been found after injuries to the head, where there has been no fracture through or near the optic foramen, but where the extravasation has

been simply the direct extension of hæmorrhage at the base of the brain. This may occasionally happen, even when there has been a history neither of severe blow on the head itself nor of concussion of the brain, and the patient has perhaps only fallen heavily on his feet. The prognosis in such cases is probably more hopeful than when there has been fracture of the base, although an increase of the hæmorrhage is to be feared from vessels which were so easily ruptured, and are, therefore, probably, diseased.

In all severe injuries to the head, there may be more immediate damage to nervous structures themselves—rupture, for example of the optic nerve, laceration or rupture of the commissure, of one or both of the tracts. Lesions such as these are hardly likely to occur alone. There is yet another class of cases where, after severe concussion-injuries of the brain, the vision of one or both eyes begins to be impaired some time after the accident, and where the immediate effects upon the sight were nil. In these cases, ophthalmoscopic examination frequently reveals the presence of changes in the optic disc, such as are seen in the various stages of optic neuritis from non-traumatic causes. Seeing that optic neuritis may advance considerably without any impairment of the normal acuity of vision, it seems highly probable that, in many cases where optic atrophy is discovered at a considerable length of time after head-injury, examination of the fundus might have revealed the early stages of neuritis, had attention only been called thereto by impairment of sight. Ophthalmoscopic examinations after injuries to the head have been, as yet, far too few to warrant any decisive opinion on this point, but in the not uncommon cases of optic atrophy, discovered at some distance of time from the accident, the changes in the fundus are probably the result of a neuritis which has run through its various stages without causing noticeable loss of vision, and which has gradually gone on to atrophy and blindness.

A routine use of the ophthalmoscope by surgeons is therefore most desirable, as thereby alone can a settlement be made of these various interesting points in connection with blindness arising after head-injuries, for it is useless to wait for the symptom of blindness before examination is begun. The changes must be observed at their very beginning, the time of their origin noted, and their progress recorded from day to day, for otherwise the opportunity of treatment will be lost, at the

time when alone it can be of any service. In such cases, it is probable that the optic neuritis originally starts in connection with some basal meningitis, the result of injury, contusion it may be, of the substance of the brain. This seems to have been the sequence of events in a case brought before the Ophthalmological Society by Dr. Coupland, where total blindness supervened in about three weeks after a severe fall upon the head. The necropsy showed that there had been extensive contusion, both superficial and deep, of the brain without fracture of the skull; and a basal meningitis which 'in extent and disposition singularly imitated the favoured region of tubercular inflammation.' Cases like this throw light on the development of optic neuritis after severe head-injuries, even when there is no fracture; and in all probability the condition is much more common than is ordinarily supposed, from the simple fact that vision may be at first unaffected and therefore no ophthalmoscopic examination is made. At any rate, meningitis at the base has been found both with and without fracture, extending by direct continuity along the sheaths of the optic nerves, even within twenty-four hours of accident. Death is due in all probability far more to the severity of the injury to the brain than to fracture of the skull, but, if the patient survive, it must depend largely upon the amount and extent of the meningeal inflammation whether vision is restored or whether atrophy will result.

Opinions differ amongst surgeons as to the influence which the administration of mercury may have in helping the absorption of inflammatory products upon the membranes of the brain; but, looking to the ill-results which are pretty sure to follow from the organisation and pressure of lymph on the optic nerves, chiasma, or tracts, it is hardly right, by withholding mercury, to deprive the patient of what may be his only chance of complete recovery from the baneful effects of inflammatory exudation, the result of injury at the base of the brain. In all these cases it is desirable, if possible, to gain some definite information as to the exact site of the original blow upon the skull, for not only does this to a large extent determine the position of the basic fracture, but we may also learn therefrom at what point there is likely to be hæmorrhage or contusion of brain-substance from *contrecoup*. Impairment of the sense of smell from damage to the olfactory bulbs is frequently caused by severe blows or falls on the back

of the head, and the like phenomenon of injury to, or in the neighbourhood of, some part of the optic nerve apparatus, may be caused by injuries apparently inflicted at remote parts of the skull. It is not inconceivable, moreover, that hæmorrhage may occur from injury in the substance of the brain at such a site as to cause amblyopia by involving the visual centres. A careful examination of the field of vision in both eyes can alone lead to a diagnosis, together with accurate knowledge of the results of experimental and pathological observation as to the central origin of the nerve fibres which go to different parts of the retinae.

Again, vision may be impaired by the more direct pressure of blood upon the eyeball itself by large extravasations within the orbit, which may even cause exophthalmos. Here is a definite physical sign of blood-extravasation after injury, which of course varies with the amount of blood poured out, and usually occurs immediately after or within a few hours of the accident. Pain in the orbit and impaired movement of the eye are likewise present in such cases; but it is by no means clear how vision may be disturbed, whether by immediate pressure on the eye or by pressure on the optic nerve. Ophthalmoscopic examination has revealed both diminution in the size of the arteries and distension of the veins, as if from pressure; and the ultimate result no doubt depends upon the length of time such pressure lasts. In all probability there is some more serious injury than simple blood-extravasation, which will lead to a fatal issue at an early date; but, if this be escaped, the surgeon will do well by careful pressure to restore the eye to its natural position, and so help, moreover, in the absorption of the blood.

Recovery is usually complete, for, unless it be a gunshot accident, the eye itself is rarely injured, so securely is it protected from concussion by its various cushion-like surroundings. A risk there is, however, in such cases that the hæmorrhage may be from some vessel of more than capillary size, and that aneurism may ultimately result. Upon the position of the aneurism the character of the impairment of sight will depend, whether the pressure thereof be upon the optic nerve, upon the globe itself, or on the nerves which supply its various muscles. *See ORBITAL ANEURISM.*

Severe injuries of the head may also cause impairment of sight, or rather interference with perfect binocular vision, by simultaneous damage to one or more of the

nerves which supply the muscles of the eye. Here, again, the symptom diplopia may be developed either early or late—early, when in all probability the nerve has been completely torn through at the moment of the accident, or is pressed upon by rapidly extravasated blood; late, when the pressure of meningeal thickening or inflammation interferes with the proper function of the nerve or nerves so affected. The diagnosis of the various forms of diplopia are not dealt with in this article. The muscular paralysis may ultimately pass away, but let it be remembered that even in traumatic paralyses of individual ocular muscles, the course of recovery may perchance be retarded by a syphilitic element, the treatment of which will best remove the special symptoms apparently due to injury alone. *See OCULAR MUSCLES, Affections of the; STRABISMUS.*

The effect which severe blows in the neighbourhood of the orbit have upon vision, has long been a matter of observation amongst surgeons, and, in pre-ophthalmoscopic days, it was generally believed that vision was impaired through the influence of the fifth nerve, which, being damaged in one of its branches, wrought some change by reflex or other agency upon the nutrition of the eyeball itself. It is very questionable, however, whether such is the real sequence of events, and whether there is any true relationship of cause and effect between injury in this region and ultimate deterioration of sight; although it seems not altogether unreasonable to conclude that a severe lesion, causing neuritis, for example, of the supra- or infra-orbital branches of the fifth nerve, might indirectly produce some effect upon an organ lying so near, and supplied by other branches of the same cranial nerve. The ophthalmoscope, however, has shown that, if we exclude the cases where a severe blow near the orbit has caused damage to the eye itself, rupture of iris or lens-capsule, detachment of retina, rupture of choroid, or hæmorrhage into the vitreous, there remains hardly any case to support this doctrine; and lesions which may cause severe injury to one branch of the fifth, the infra-orbital, in fractures of the upper jaw, are not commonly followed by any impairment of sight. This result has apparently arisen only in cases where the injury has had the indefinite description of a severe blow in the neighbourhood of the orbit, and no ophthalmoscopic examination has been made. It is true that many cases are to be found, in medical literature, which seem to establish

the fact that injury to a branch of the fifth may lead ultimately to amaurosis; but this also is not less remarkable, that cases of the kind are becoming rarer day by day, as the ophthalmoscope throws light on hitherto unseen parts of the eye itself, and as pathological investigation shows by what central lesions sight may be affected or destroyed.

Passing to other and more special forms of accident, we find that impairment of sight is a not uncommon complaint of patients after railway collisions.

The symptom varies much in importance in different cases, but it is usually a passing condition, wholly independent of structural change. It cannot indeed be said that railway accidents give rise to any special or characteristic form of loss of vision, for the impairment, whether temporary or lasting, differs not in the least from that which may be induced by injuries in other accidents, of every form and variety. The circumstances of a railway accident are merely such as to provide the requisite causes of certain disorders of vision. The commonest is simple asthenopia, which may or may not be associated with some error of refraction. The patient complains that reading or fine work is difficult or impossible, because the lines run together and rapidly become blurred, and added thereto, if the effort be continued, is pain about the orbits and brows. Fatigue is, in fact, very early induced by the muscular effort of accommodation; fatigue of the same kind as renders any sustained effort, whether of mind or body, impossible during the state of general weakness and prostration which are the very common result of the physical and mental shock sustained in a railway collision. And, as might be expected, early fatigue of accommodation is more likely to arise in those who have some error of refraction, and in whom, therefore, an extra muscular effort is needful to bring objects to a focus on the retina.

It is not after railway accidents only that such defects may be discovered. The same thing happens not infrequently in the course of an exhausting illness, in the period of weakness following it, or in that which is induced by prolonged suckling. In a previous state of health, the muscular strength may have been adequate for the purposes of accommodation, and the defect has been unknown. Illness prostrates and the defect is revealed, for all muscular power is weakened, whether of the limbs, of the heart itself, or of the eye. That the discovery should cause consider-

able alarm, after an accident, is not to be wondered at, nor is it surprising that persons, so suffering, should with difficulty be led to believe that some more serious injury has not been inflicted, and that the failure of sight is not the beginning of an impairment which will end in blindness because of some grave damage to nervous centres. Careful testing with lenses will usually establish the diagnosis and indicate the treatment; but as long as the condition of nerve-prostration lasts, it is idle to hope for complete relief for the asthenopia by the use of glasses. Returning strength alone can restore the ciliary muscle to its natural vigour, but it is only in cases of emmetropia, or in the slighter grades of ametropia, that the patient will probably be able in the future to dispense with glasses.

When the refractive error is considerable, glasses will in all probability be found a permanent necessity; but, if the asthenopia is simply due to general weakness alone, the trouble will completely pass away. The same remarks apply to those in whom presbyopia is just commencing; and when this condition is well advanced, any severe shock or illness will in all probability entail a further presbyopic change, which will call for stronger lenses. Given, then, after railway collision a case where there is no question as to the genuineness of the symptoms, asthenopia becomes a symptom of some value in forming an estimate of the general muscular and nervous prostration. It is in these cases that *muscæ volitantes* are so often troublesome; but they are of no pathological significance, being due to the presence of small floating bodies in the vitreous. In the severer forms of neurasthenia after railway collision, we sometimes meet with a considerable degree of photophobia; but it is impossible to say on what the condition depends. It is associated with extreme general prostration, and does not seem to have any definite pathological basis. The state of nervous exhaustion from shock is often accompanied, perhaps is caused, by extreme feebleness of circulation, and it is possible that asthenopia may in some cases be due to a general retinal anaesthesia so to say, whereby there is concentric limitation of the field of vision. To cases apparently of this nature the term 'reflex amblyopia' has been recently given by Mr. Priestley Smith (*Ophthalmic Review*, May, 1884). The condition seems to be independent of any discoverable pathological change, and the tendency is

towards complete recovery, when the general health has been restored.

Symptoms such as these are naturally extreme in persons of an hysterical or emotional temperament, and when it is remembered that an emotional state is frequently induced in both sexes by the shock and fright of a railway collision, and that hysteria—using the term in the very broadest sense—is so commonly developed thereby, it is not strange that they should be common results of such accidents, and it is needful to exercise the greatest caution in forming a diagnosis. Complaints of bad sight are, moreover, very open to exaggeration, and the difficulty of diagnosis may often be great when we have to rely upon the statements of the patient alone. Let care be taken that normal physiological varieties, such as may be seen in the colour of the fundus oculi, in the distribution of the vessels, or in the appearance of the disc and its margin, be not mistaken for pathological changes. Certain it is that pathological changes as the result of railway accidents, spinal or otherwise, are extremely rare; and this is the common experience of ophthalmic surgeons and in ophthalmic hospitals, although the vast number of persons who have been hurt in railway accidents might have afforded many examples of eye-disease. It is in cases of railway injury, moreover, when the prospect of compensation opens out so great a temptation to exaggeration, imposture, or untruth, that the surgeon may be called upon to decide the important question, whether and how far some existent pathological condition is due to any injury received, or whether it has preceded the accident, and is really altogether independent of it. A patient may assever, with every semblance of truth, that his sight has been impaired or destroyed by the accident, and ophthalmoscopic examination may reveal pathological changes amply sufficient to account for the defect, or it may fail to find any lesion at all. In the latter case it will be essentially necessary to make repeated examinations, at short intervals, to discover whether any changes in the fundus oculi of an atrophic character do gradually become developed, before speaking with certainty as to the truthfulness of the patient; while, if other circumstances of the case throw doubt upon his *bona fides*, and special examination with prisms and coloured glasses, &c., referred to in another article, detects unquestionable flaws in his statements, the absence of pathological changes will of course tend to

support the conclusion that the loss of vision is either imaginary or assumed. See VISION, Feigned Disorders of.

More difficult, however, of decision and certain etiological diagnosis, are the cases where pathological changes undoubtedly exist and the patient at the same time assures you that his failure of sight, or even his blindness, dates from the time when he was subjected to injury. Are the discovered changes due thereto either wholly or in part, or have they been pre-existent and been aggravated by the alleged injury sustained? In the decision of these points, on which important medico-legal questions may depend, certain possibilities must be borne in mind. The patient may, for example, have been totally ignorant of his blindness or failure of sight in one eye, even though of long standing. This is a matter of common observation, and it is well recognised that a cataract of one lens may have advanced to almost complete opacity before the patient accidentally becomes conscious of the fact; and the same ignorance may at times be displayed in the case of other and more deep-seated lesions. That such discoveries should coincide with, or shortly follow, the receipt of railway or other injury, is not to be wondered at, when it is remembered that asthenopia due to failure in accommodative power is so common after such accidents, and that a patient then for the first time has his attention specially directed to his eyesight.

The surgeon may also meet with cases where a patient has been perfectly aware of his defect, and yet persistently declares that his old complaint is really new, and therefore presumably due to the injury sustained. Granted that he has had an adequate experience of eye-diseases, the judgment of the surgeon is far more valuable than the asseverations of the patient, in the presence of familiar pathological changes, for it may be to the great pecuniary advantage of the patient intentionally to deceive. But, given an instance of perfect truthfulness on the part of the patient, no more difficult questions can well present themselves to the surgeon than the real causation of the various pathological conditions which may be met with after railway accidents. Happily, such questions but seldom arise, and they are likely to be less common as familiarity with the ophthalmoscope increases in the hands of the practitioner, and as he becomes better acquainted with the real nature of the injuries to which railway accidents commonly give rise.

The writer can call to mind a case of well-marked choroido-retinitis, and opacities in the vitreous of one eye of a patient who had received a cut over the left eyebrow, and slight momentary concussion, and who first noticed, or complained of, failure of sight in the left eye some three weeks after he had been in a railway collision. He had some years before lost the sight of the other eye from injury, and presumably therefore he would be able to say, with tolerable certainty, how much his vision had changed after the accident. The fact that he had observed no failure of sight for about three weeks seemed fair evidence that no direct blow of any severity had been received upon the eye itself. The parts about the macula and disc were perfectly healthy, but towards the equator were patches of widely-scattered choroidal atrophy due to disseminated choroido-retinitis, which none of the surgeons who examined him would have ever connected with injury in the absence of the patient's own statements, the changes being in no wise different from those met with from other constitutional causes. In the absence of a history of such causes, could a blow upon the head, or in the neighbourhood of the orbit, have transmitted such a physical shock to the globe as to rupture minute vessels in the choroid and retina, and cause scattered specks of hæmorrhage which became foci of irritation, and so set up choroido-retinitis? It seemed hardly likely that such changes, thus induced, would affect all parts of the equator, for violence would most probably produce damage at one particular spot. The appearances and the history alike negatived the supposition that recent injury was the cause of the pathological changes, and the general conclusion arrived at was that the choroido-retinitis preceded the accident, and was perhaps aggravated—who could really say?—by the blow sustained. The asseverations of the patient and the opinions of the surgeons were thus diametrically opposite, and in the end large compensation had to be paid. Years after this claim was settled and pecuniary compensation had been enjoyed for the alleged injury, it was learned that the failure of sight had really existed before the accident, and had always been attributed to the injury to the other eye. These facts, however, were carefully concealed after the railway collision, and the problem to be decided by the surgeons was as difficult as could well be conceived.

Like difficulties, of which other examples might be named, have arisen, and will again arise in other cases, and this example has been detailed at length to point the lesson that the surgeon should, in such instances, place less reliance on the patient's statements than on the results of his own examination. Let him learn an accurate account of the accident, and of the precise mode whereby injury was sustained, and let him apply his knowledge of ordinary disease to an elucidation of the disease which he finds before him. Neither here nor in any more elaborate treatise can any special rules be laid down for guidance or diagnosis in these cases of railway injury; the tact, judgment, and experience of the surgeon must avail him for the task of decision. Again, it must not be forgotten that the severe shock and fright of a railway accident very often give rise, in both sexes, to profound functional disturbance of the nervous system, and that, in the state of general neurasthenia so induced, there are likely to arise numerous varieties of functional or so-called hysterical disorders in which vision may be affected.

Complete blindness of one or both eyes, diminution of the normal acuteness of vision, limitation of the field of vision, with loss or diminution of the colour-sense, may perchance be met with, and their true significance can only be determined by the fact that they exist in conjunction with other obvious nervous disorders. Hemianæsthesia, for example, has been observed in both sexes after the shock of a railway collision; and anæsthesia may likewise involve smaller and circumscribed areas of the cutaneous surface. It is very essential to look for, and if possible discover, such evidences as these of functional nervous derangement, for their presence may form a most valuable aid to diagnosis when other features of the case may have been wholly obscure, and a diagnosis thereof difficult or impossible. Amongst them are various defects of sight of a purely functional nature, in which the ophthalmoscope reveals no evidence of structural disease. Such cases are by no means rare, in males as well as females, after railway collision or other severe accidents, and the surgeon will do well to bear the possibility of their occurrence in his mind when making his investigation.

Of greater importance, however, than these cases of simple functional disturbance, are those where some obvious pathological change is present in the fundus oculi, as a consequence or accompaniment of damage

to nervous structures remote from the eye itself. The association of morbid changes in the optic nerve with cerebral disease is a matter of daily observation; but of not less interest is the possibility of similar changes being induced by injury or lesion of the spinal cord. Many years have gone by since Dr. Clifford Allbutt first asked the question whether disturbances of the optic nerve and retina commonly follow spinal mischief, and it cannot be said that precise information on the subject is as yet anything but fragmentary. Isolated cases have from time to time been published, which show that morbid changes in the fundus oculi are sometimes met with in association with injury of the spinal cord, but there is little real evidence to establish the relationship between them of cause and effect. Optic atrophy, it is well known, is often found in cases of *tabes dorsalis*—*locomotor ataxy*—and other disseminated scleroses of the nervous system, and may, in fact, be one of the first signs of disease; but it can hardly be said that the atrophy is the result of the sclerosis in the spinal cord, and there are numbers of cases where advanced degeneration in the spinal cord has had no concomitant changes in the optic nerve. Nor is there any clearer connection between the two in cases of spinal injury. One thing only seems tolerably certain—that the higher the seat of injury to the cord the greater likelihood is there that changes may supervene in the eye, and the sooner are such changes prone to arise.

As to the nature of these changes observers seem pretty well agreed that optic atrophy, such as is met with in the system-diseases of the cord, is not seen after spinal injury, but that there may be a condition of hyperæmia of the disc and adjoining parts. In Dr. Allbutt's words, 'the retinal arteries do not dilate, but become indistinguishable, while the veins begin to swell and become somewhat dark and tortuous. The disc then becomes uniformly reddened and its borders are lost, the redness or pinkness commencing with increased fine vascularity at the inner border, which then so invades the white centre and the rest that the disc is obscured or its situation known only by the convergence of the vessels.' Such changes are of slow development, and their tendency is to end in resolution rather than in atrophy. They seem rather to point to circulatory disturbances than to primary change in nerve-tissues; but it must be confessed that the number of observations, or at any rate

of recorded observations, is as yet far too few for any settled opinion on the subject, and not only is a greater number of observations necessary, but post-mortem examinations also are needed to throw light on the association, if there be any, between cord-lesions and optic changes. The same kinds of appearances have been recently observed by Mr. Bruce Clarke in cases of spinal injury, and have been recorded in *St. Bartholomew's Hospital Reports* (vol. xvi.), the distinguishing characteristics of them being that the hyperæmia was seen early and was essentially transient. Thus, in a case of fracture of the fourth, fifth, and sixth cervical vertebræ with complete division of the cord at the level of the fifth and sixth, there was noted on the third day 'well-marked hyperæmia with considerable cedema of both discs; a good deal of effusion obscuring the vessels in many places.'

The facts, then, seem to be established so far that occasionally after spinal injury, and most commonly when the injury is high up, changes in the fundus oculi are to be found, consisting chiefly of a hyperæmia, either transient or longer continued, which leads to obscuration of the disc itself; and, further, that this hyperæmia may or may not be associated with, or give rise to, impairment of vision. The actual relationship between the two conditions is not, however, by any means clear, and no observations have yet been recorded to shake the suggestion of Dr. Clifford Allbutt that the changes are probably dependent on a greater or less extension of the meningeal and vascular irritation from the spinal cord up to the base of the brain. For it is well recognised that encephalic meningitis is a not uncommon accompaniment or extension of spinal meningitis, and it seems highly probable that optic changes arise only when this extension has taken place. The same conclusion, as to the absence of any more immediate relationship, seems to be borne out by those cases of disease in which acute optic neuritis has been found associated with acute myelitis of the spinal cord.

A goodly number of such cases have now been published, but it is noteworthy that in several of them the optic neuritis has actually preceded any evidence of mischief in the spinal cord. Markedly was this the fact in a recent case brought before the Ophthalmological Society by Dr. Sharkey, where failure of sight and acute optic neuritis began at least a month before the myelitis of which the patient ultimately died. No connecting link whatever could

be found *post mortem* between the neuritis and the myelitis, and the inference seems inevitable that both were merely the widely separate manifestations of one disease arising from some common cause. At any rate, the association of the two phenomena is so rare, that it is impossible to lay it down as an established pathological fact that optic neuritis is caused by myelitis; nor do present facts allow of our saying more than this, that the less serious phenomenon of optic hyperæmia, whether transient or of long duration, is sometimes found accompanying injuries at the upper part of the spinal column. Be the connection, however, what it may, it is obvious that such morbid changes in the fundus oculi may be of considerable diagnostic importance after obscure injuries to the upper part of the spine.

Although the significance of these pathological changes in the deeper parts of the eye is a matter of uncertainty, the more visible phenomena of alterations in the pupil, with which we have next to deal, seem to have a closer relationship of cause and effect with injury to the upper part of the spinal cord, and of the nerves which come off from it, of those which go to form the brachial plexus, and of the sympathetic nerve itself. Injury of any one of these various nervous structures may give rise to changes in the size and activity of the pupil, which in the main confirm the results of experimental observation, both as to the origin of the nerve-trunks and their association with the sympathetic, and of the connection which this in its turn has through them with the upper part of the spinal cord. Let it be noted, however, in the first place that, other causes having been carefully excluded, the size of the pupil gives a very fair indication of the patient's general nervous tone; that if the tone be low the pupils are often large, and that dilatation of pupils may be due to defective tone of the retina and nerve-centres, and to the fact that a larger supply of light is necessary in such conditions. This has been pointed out by Mr. Hutchinson, and his observation certainly holds good in the state of general nervous prostration which is so common after the severe shock of a railway accident.

Here it is impossible to enter into those physiological questions which are of great interest and importance in connection with the sympathetic nerve and its association with the eye. Suffice it that well-marked oculo-pupillary symptoms are induced both by division and irritation

of the sympathetic in the neck, and that the same phenomena may be caused by division or injury of the lower roots of the brachial plexus and of certain regions of the spinal cord. Leaving aside the well-known vaso-motor phenomena which follow division of the sympathetic, phenomena which seem rather to affect the vessels of the side of the head and neck than of the eye and orbit, together with alteration in temperature of the affected area, the symptoms caused by division of the sympathetic in the neck are contraction of the pupil—paralytic myosis—retraction of the globe of the eye, diminution in size of the palpebral fissure, some flattening of the cornea, and occasionally slight rolling inwards of the eyeball. Irritation of the sympathetic gives rise to exactly opposite phenomena, and a region in the spinal cord extending from about the sixth cervical vertebra to the third or fourth dorsal has been named the 'regio cilio-spinalis,' and by Bernard the 'centrum oculo-pupillare,' because irritation thereof causes the same phenomena as irritation of the sympathetic trunk itself. While, however, these symptoms may readily be induced experimentally on animals, as to injuries of the spinal cord in man little more can be said than this, that sometimes one or both pupils are contracted, or non-dilatable, as in some cases recorded by Brodie, sometimes one or both may be dilated, and that these opposite conditions are in all probability due to differences in the nature and precise position of the lesion. One cannot say for certain what lesion of the cervical or upper dorsal cord it is which will certainly give rise to this or that form of oculo-pupillary symptoms, but recorded observations seem to show that paralytic myosis is much more common than mydriasis. Division of the trunk of the sympathetic, however, gives rise with comparative certainty to the appearances already named.

With reference to this paralytic myosis it must be remembered that the condition is not one of spasm of the circular fibres of the iris, but that the pupil has simply lost the power of dilatation because of palsy of its dilator fibres, and that, in a fairly bright light, there may therefore be no noticeable inequality in the two pupils. This is only revealed when the patient is placed in a dull light; but even then we must beware lest the condition be mistaken for paralysis of the third nerve with consequent mydriasis, and it is necessary, therefore, in order to arrive at a correct diagnosis, to observe the state of the pupils both in light and shade.

'Inequality in the size of the pupils,' Mr. Hutchinson wrote many years ago, '*the smaller one being the fixed one*, is then the cardinal symptom of paralysis of the sympathetic, just as inequality of the pupils with the larger one fixed is the cardinal symptom of paralysis of the third nerve, as far as supply to the iris is concerned.' Paralytic myosis is the most pronounced and most usual symptom, retraction of the eyeball being by no means well-marked in all cases. This latter phenomenon is due, in all probability, to paralysis of the musculus orbitalis, whereby the recti are enabled to draw the eye deeper into its socket, and is often more marked in animals after experiment than in man. The muscle is probably less well-developed in man than in animals, and may perhaps even be absent, so that this symptom of its paralysis is very variable. The same variability is also to be noted in the narrowing of the palpebral fissure, which may be due in some degree to the lids having lost the natural support of the eyeball, or to paralysis of the muscular fibres in the lids, or '*musculus orbitalis*' of Müller, which are supplied by the sympathetic. In one of Weir Mitchell's cases of injury of the sympathetic in the neck from a bullet, the pupil was not only contracted, but was also slightly deformed, being oval rather than round. There was also slight ptosis, and the outer angle of the eye seemed to have dropped a little lower than the inner. Some or all of these phenomena, it must be borne in mind, may be induced by the pressure of new-growths on the sympathetic, and it is well recognised that oculo-pupillary changes may give valuable diagnostic help in suspected aneurism of the root of the neck.

All that has been written above with reference to the symptoms of paralysis of the sympathetic might be repeated in a description of the symptoms caused by rupture of the roots of the brachial plexus, many cases having been published in which the same oculo-pupillary phenomena had been caused by this injury. Symptoms, of apparently greater physiological than surgical interest, may thus be of considerable diagnostic importance in deciding between cerebral and peripheral lesion as a cause of extensive palsy of one arm, the result of injury. There seems to be a general consensus of opinion that no lasting changes are to be seen in the retina in the subjects of these injuries, although, in experimental observation on rabbits, after division of the sympathetic some hyperæmia has been noted. Alterations in temperature do not

usually last long, but minute observations on this point in the human subject are as yet wanting. The inconvenience to the patient appears to be small. Slight difficulty in accommodation is all that has been observed, even though the paralytic myosis may have lasted for years. There is no evidence to show that the nutrition of the eyeball is interfered with in the least; but it has been pointed out by Mr. Hutchinson that occasional giddiness is complained of, owing to 'inability on the part of a tract of the vaso-motor nerve to regulate the calibre of the cerebral arteries, and thus control the supply of blood to a certain portion of the brain.' It is possible also that this may likewise be the cause of the dimness of vision which is sometimes felt in these cases; but, if with Eulenburg and Guttman we regard the functions of the sympathetic as divisible into three groups—the oculo-pupillary, the vaso-motor, and the trophic—it must be admitted that it is in the domain of the first of them that changes usually fall under the notice of the surgeon.

HERBERT W. PAGE.

VISION, Feigned Disorders of.—What may be designated the real disorders of vision are dealt with under the various heads of ACCOMMODATION; AMAUROSIS; AMBLYOPIA; REFRACTION, Errors of, &c. In this article only the feigned or simulated disorders will be considered. Even these will be discussed rather from the diagnostic than from the pathological point of view.

SIMULATED AMAUROSIS.—Amaurosis is occasionally, though not very frequently, simulated, certainly less frequently than amblyopia or mere impairment of vision, and for the obvious reason that it is much more difficult to keep up the deception in the latter than in the former case. A single slip or act of forgetfulness will discover the one, whilst it may easily pass unobserved in the other. The simulation of amaurosis in one or in both eyes is practised by those who wish to escape conscription, in countries where military service is compulsory, and is also sometimes observed as one of the vagaries of hysteria and pregnancy. It may be pretended, and with considerable chance of success, by those who have some real defect of vision, such as may result from cloudiness of the cornea, lens, or of the fluid media of the eye, or from some lesion of the optic nerve.

Simulation of Bilateral Amaurosis.—When amaurosis of both eyes is simulated, the surgeon who is called upon to determine whether a fraud is being prac-

tised or not must take all the circumstances of the case into consideration, and reflect whether any probable or sufficient motive exists for its perpetration. As a general rule, the dilatation of the pupil in amaurosis is moderate, and no contraction of the iris can be observed on sudden exposure to bright light. Extreme dilatation excites suspicion that atropine has been employed. The discovery of an impostor pretending to be blind may be, and has been, effected by persistent, though unobtrusive, watching; by observing whether the patient avoids obstacles, picks up coin placed in his path, or performs any act requiring vision. As a rule, some physical changes are observable in the eye with the aid of the ophthalmoscope, such as white atrophy of the optic disc, hæmorrhages or inflammatory changes in the choroid or retina, especially at or near the yellow spot.

Simulation of Unilateral Amaurosis.—The movements of the iris assist the surgeon in the diagnosis of simulated unilateral amaurosis. When healthy eyes are suddenly exposed to light, or are made to converge upon a near object, both pupils can be seen to contract. Moreover, if one eye be shaded whilst the other eye is alternately exposed to light and darkness, it will be found that the pupil of the shaded eye contracts and expands simultaneously with the other. This is termed the consentaneous action of the two pupils. In addition, it may be remarked that when a near object is intently regarded, contraction of the pupils occurs, which is a movement functionally associated with the act of accommodation. The reaction of the pupil to light shows that the retina is sensitive to light, and that the impression is conducted to the brain through the optic nerve, and occasions a reflex impulse to be propagated through the third nerve. This may be unattended with conscious perception of light, but it is suggestive of simulation. Consentaneous action, with the play of the opposite pupil when one eye is perfectly blind, may occur, though it is usually feeble in real amaurosis. The absence of any movement of the pupil in one eye, when exposed alternately to light and shade, whilst contraction and expansion occur simultaneously with the movements of the healthy eye, would supply strong evidence of the genuineness of the complaint. Dr. S. Baudry remarks: 'When no information can be gained from direct inspection, we must adopt physiological proceedings, which are for the most part of the nature of a surprise, and, as several of them

depend on the accuracy of the statements of the patient, it is necessary for the surgeon to see that he does not close one eye, and to state frankly that, if he persists in doing so, the experiment will be regarded as having demonstrated the excellence of his vision in the eye declared to be at fault.'

In simulated unilateral amaurosis, a method in common use for its discovery is to cover the sound eye, and then for the surgeon to make, with a pencil or penknife, a sudden stabbing movement. Reflex closure of the lids on the first attack, if the patient sees, is almost unavoidable, or can only be overcome by considerable practice. A second method is that of Dujardin, to place before the sound eye an ordinary convex glass, 16 D, and place the patient at twenty feet from the usual test-types; if he is able to decipher any letters, the eye complained of is not blind. A third method is that of Javal—viz. to interpose a ruler held vertically between the sound eye and a line of print: words will be read which the surgeon, by a previous experiment on himself, knows could not be seen except with the eye in which blindness is simulated. Stilling recommends, for the discovery of the fraud, a test with coloured glasses. A word is placed before the patient, one half of the letters of which are red and the other half green, painted with transparent colours on an opaque ground. In 'friend,' for example, 'f, i, n,' are green, and 'r, e, d,' are red. Then, whilst leading the patient to believe we are testing the healthy eye, we place before it a red glass, the colour of which exactly corresponds with that of the red letters. This will permit the healthy eye to see the red letters, but will altogether prevent the green from being seen, so that if the patient be really amaurotic in the eye he declares to be blind, he will say he sees the letters 'r, e, d.' In the event of his recognising all the letters, and reading the entire word 'friend,' it is clear that he is perceiving the green ones, 'f, i, n,' with the eye he states to be blind; and by having a set of coloured types similar to those of Snellen, we may go a step farther, and measure the visual acuteness of the impostor's blind eye.

Another method is by means of prisms. In normal vision the eyes converge upon the object, and the divergence or wandering of an eye, when an object in near and middle distance is fixed, is strong presumptive, though not absolutely certain, evidence of some imperfection in its vision. By means of a prism, it is not difficult to make one eye wander without the control of the

patient in certain directions, and the movements which may be observed when vision exists in both eyes constitute the method of Wetz. In this method, a prism of about 14° is placed before the eye stated to be blind, with the base outwards. In order to obtain single vision, if the patient sees with this eye, he rolls it inwards, and again rolls it outwards when the prism is withdrawn. This movement and the subsequent rectification do not take place in cases where one eye is really blind. Berthold has suggested a slight difference in the application of this method—namely, the rotation before the supposed blind eye of the prism, when it will be found very difficult to read small print or decipher small signs, in consequence of the superposition and interference of the images.

The method suggested by Von Graefe, as modified by Baudry, consists in puzzling the patient with double images by placing a prism before one eye. The proceedings should be divided into two stages or periods. The first should be directed to making the patient comprehend, what, as Giraud-Teulon observes, he often knows and believes beforehand, that he may have double vision with one eye. For this purpose the blind eye or eye supposed to be blind is covered, a prism with the base upwards is brought upwards till it divides the pupil horizontally into two halves, and he is directed to look at a distant candle; he at once sees two images, one above through the natural pupil, and the other through the prism, the latter being projected below the other. This is tried several times, and in various ways, until the patient is satisfied of the fact; then, apparently unconsciously and without display, and as though by forgetfulness, the supposed blind eye is set free, whilst at the same moment the prism is raised so as to cover the whole pupil. If the patient still sees two images, the simulation is exposed.

A modification of this method has been devised by Galezowski, which consists in using a double refracting prism of Iceland spar, a method that has been again improved upon by M. Monoyer, who employs two prisms united by their bases, by which means simple or binocular diplopia may be produced at will, according to whether one of the prisms or the line of junction is in front of the pupil.

The method in which the stereoscope is utilised is also employed for the discovery of simulated monocular blindness. In this the photograph is replaced by a sheet of white paper, divided into two equal parts by a vertical line. Near the top of the sheet,

at a distance from the vertical line of two centimètres, are symmetrically fixed two wafers of different colours, say, red on the right and green on the left; near the bottom of the page, and at a distance of five centimètres from the vertical line, two other wafers are placed, also symmetrically, say, blue on the right and black on the left. If binocular vision exists, the wafers distant two centimètres from the vertical line give crossed images, whilst those distant five centimètres give direct images. If an eye is really blind, supposing it to be the right, the patient would see the red and the blue.

Simulation of Amblyopia.—The simulation of amblyopia is more common than that of amaurosis. He who pretends to be completely blind, requires to be constantly on his guard, lest by some unwary movement or observation he betrays that he possesses vision; whilst the man whose vision is only, according to his own account, dim, may act in a way that may indeed excite suspicion or distrust, but is hardly sufficient to convict him of imposture. Yet there have been men, who, pretending blindness, have been so collected as to avoid all the traps laid to expose their deceit, and even, at considerable risk, to walk without hesitation into water or into a pit. Before the invention of the ophthalmoscope, the objective examination of the patient ceased with mere inspection of the eye; and dilatation and immobility of the pupil, with a particular and easily imitated gait, were regarded as most important reliable signs of blindness. But even these were known to be absent in some cases of genuine amaurosis; and so many causes of this affection existed, of which no account could be given, that when such simple proceedings as the placing of a coin or other object in the path of the supposed patient failed to surprise him, no other course was left than that of watching him, which soon became wearisome, and was only continued for a period so short that he was, without much strain on his attention, able to maintain the deceit. The use of the ophthalmoscope has rendered the simulation of blindness far more difficult. Yet it must be admitted that, even with all the aid this instrument affords, cases still occur in which, on the one hand, the most careful examination fails, for a time at least, to discover the slightest disease in the interior of the eye; whilst, on the other hand, it sometimes reveals conditions which, if the patient declared he was blind, would be regarded by any ophthalmic surgeon as sufficient to

justify his statement, and which may yet be compatible with very good and useful vision. To meet these difficulties, various methods have been adopted, some of which depend for their success on the statements of the patient, and require considerable intelligence on the part of the surgeon to render them reliable, whilst others rest on circumstances beyond the control of the simulator.

It not infrequently happens that an artisan receives an injury to one eye which temporarily incapacitates him from work, and, his club ceasing to furnish supplies, he seeks to prove that the lesion is permanent, and founds a claim against his employers. He may declare that one eye is completely blind, or only that the acuteness of vision in it is so far dulled that it seriously interferes with his work. The former case is more easily discovered than the latter, but, in both, circumspection is required on the part of the surgeon. He should first make a careful ophthalmoscopic examination and satisfy himself whether serious organic mischief is present or not, whether the media are clear, whether there is any hæmorrhage or effusion, whether the disc presents signs of atrophy, and whether the vessels are normal in their position, colour, size, and course. He should then proceed to test the refractive power of the media by retinoscopy or by means of the ophthalmoscope, for hitherto unsuspected and unknown defects of refraction are sometimes rendered conspicuous by the loss of accommodation which follows a sharp blow on the eye.

It is, of course, useless to place the patient before a set of test-types and ask him what he can see. He either says that one or both eyes are blind, or admits only a certain amount of vision. Where both eyes are stated to be blind, the proceedings already mentioned under the head of *Simulation of Bilateral Amaurosis* must be adopted; but, when only impairment of vision in one or both eyes is complained of, something may be learnt from careful observation of the patient's behaviour in regard to test-types. If, for example, he can make out letters of a given size at a certain distance, he should be able to read letters of a quarter this size at half the distance, and of four times this size at double the distance, or at least any great discrepancy should awaken suspicion. Again, a lens of slight magnifying power may be placed before the eye or eyes, and if he admits that he sees a little better, it may be somewhat ostentatiously

and positively stated that a lens of double the power will further improve the vision though it will by no means make it perfect. The patient's suspicions being allayed, instead of adding a second convex lens, a concave one of the same power may be added, which, of course, neutralises the first, and has no more effect than a piece of plane glass. Yet the patient will sometimes name letters far smaller than those which he at first stated were the extreme limit of his vision.

If no defect can be discovered, and blindness of one eye be declared to be present, it must be borne in mind that such blindness may result from shock to the retina (*commotio retinæ*), as from blows with champagne-corks, in which case, however, if the blow has not been very severe, recovery usually soon follows; or, in cases of falls on the head, from injury to the optic nerve in the optic foramen, in which case, white atrophy usually soon follows. If, however, doubt exist as to the statement of the patient, attention must now be paid to the state and reactions of the iris. In amaurosis, the pupil is usually, but not always, dilated and motionless, and it can be, as is well and generally known, rendered so by atropine, which is therefore used for the purpose by impostors.

As a means of diagnosing amblyopia M. Dariez recommends the employment of feeble currents of electricity. The healthy eye as a rule responds by a luminous sensation to an interrupted current, the strength of which does not exceed one-tenth of a mille-ampère. In atrophy of the optic nerve resulting from primary sclerosis or concomitant with medullary sclerosis, in cases of atrophy from neuritis, embolism, hæmorrhage, or glaucoma, in fact in all those cases in which the forecast is bad, the electric phosphene can only be produced by currents amounting to 5, 10, 50, or 100 tenths of a mille-ampère. On the contrary, in toxic forms of amblyopia, such as those resulting from tobacco and alcohol, the reaction is normal, as it is also in cases of congenital and hysterical amblyopia.

HENRY POWER.

VISUAL ACUITY.—It is of the utmost importance, in order to estimate the degree of functional perfection of the eye, as well as to ascertain from time to time the result of our treatment or surgical interference in any case, to have some means of testing and recording the acuity of vision, which shall furnish us with results both accurate and capable of comparison *inter se*. For-

tunately we do possess such means, and so simple and easily applied are they that the habit of neglecting them and contenting oneself with the more or less vague statements of patients as to improvement or deterioration in their sight is little short of unpardonable. In testing the sight it is not sufficient to note the size of print which the individual is able to read, as a little experience will soon convince one that even the smallest print can be read by persons possessing very different degrees of acuity of vision. The proper test is made at a distance, and rests on a scientific basis which will be shortly explained.

The individual to be tested is placed at the distance of six mètres, or twenty feet, from a board on which are printed seven rows of letters, the so-called Snellen's test types, each row except the top containing different letters of the same size, but the size of the letters becoming smaller and smaller in each successive row. The top letter is of a size capable of being distinguished at the distance of sixty mètres, or 200 feet, whilst the distances at which the letters of the 2nd, 3rd, 4th, 5th, 6th, and 7th rows might be made out are 36, 24, 18, 12, 9, and 6 mètres, or 100, 70, 50, 40, 30, and 20 feet respectively, according as the boards have been constructed for metrical or ordinary notation. It is clear that anyone placed at six mètres from the board, and only being able to distinguish the top letter, might have the acuity of his vision expressed by the fraction $\frac{6}{60}$ or $\frac{20}{200}$, inasmuch as an object, the shape of which can be made out at 60 mètres with the normal eye, can only be seen by him at 6 mètres. There is an advantage in retaining the fraction in this form, and this is almost always done, instead of reducing it to the simpler form $\frac{1}{10}$, as the numerator gives the distance at which the individual tested is placed from the board, and the denominator indicates, by the distance at which it should be visible, the line he sees. If he does not even see the top line at six mètres, he may be approached to the board until he sees it, then if he sees it first at four mètres, his vision is $\frac{4}{60}$. On the other hand, though he is unable to see the second line at six mètres, he might still see the first at seven or eight mètres, corresponding to a degree of visual acuity equal to $\frac{7}{60}$ or $\frac{8}{60}$. It is not, as a rule, convenient or even possible, however, to make examinations at so great a distance, so that it is customary rather, under such circumstances, to test the distance at which the second line is seen instead, in the case in point, say, at four or five mètres, giving a fraction for

the acuity expressed nearly by $\frac{4}{36}$ or $\frac{5}{36}$. The acuity of vision corresponding to seeing 2nd, 3rd, 4th, 5th, 6th, or 7th line and no more is, adopting the same notation, $\frac{6}{36}$, $\frac{6}{24}$, $\frac{6}{18}$, $\frac{6}{12}$, $\frac{6}{9}$, and $\frac{6}{6}$. The last, or $\frac{6}{6}$, i.e. when all the letters in the last line can be made out at six mètres, indicates the possession of normal or full visual acuity.

In the same way, as already explained, we may obtain intermediate fractions, though it is seldom that a greater degree of accuracy is desirable, and indeed it should not be aimed at except in cases where we are certain that the circumstances are always exactly similar during the period of examination. Thus we should have to know that the illumination was the same, and that the individual tested was not influenced in his answers by practice and having previously known the letters, as might be the case after repeated examination, or when one eye was considerably better than the other.

In cases where the vision is extremely bad, the test types become inapplicable, and it is usual then to find the distance at which the patient can count the outstretched fingers against a dark ground, noting the result in the following way: V = fingers at 1 foot, 2 feet or more, as the case may be. The vision may be so bad as to render the patient incapable of counting fingers even close up to his eye; still he may have sufficient vision to see the movements of the hand, up and down and from side to side—a degree of vision which may be expressed by noting V = Hand movements close, at 1 ft., 2 ft., &c., according to the distance. When there is not even perception of light we have V = 0.

Let us now consider what we mean by visual acuity, and what are the natural limits to it. It is a very popular belief that if we see objects at a great distance we must necessarily have good sight, but this is by no means the case, as an object may be seen at practically almost an infinite distance provided it be sufficiently luminous, yet we may be very far from being able to make out any detail in it. The visual acuity is scientifically determined by the smallest visual angle under which two or more objects, if presenting sufficient contrast to the intervening space, can be made out as separate, discrete objects. If a straight line be drawn from any point in an object to the first nodal point of the eye (towards the back of the lens), the position of the image of that point on the retina is given by drawing a line parallel to the first from the second nodal point to where it meets

the retina. The two lines determining the positions of the images of two points will accordingly necessarily form an angle between them, the apex of which angle lies at the second nodal point. It is this angle which is called the *visual angle*, and it evidently equals the angle formed by the two lines drawn from the separate points to the first nodal point, or, what comes to the same thing practically, when considerable distances are involved, the angle formed by the lines passing from the two points to the centre of the cornea.

Knowing, then, the distance from the eye of two points, and their distance apart (or more correctly the component of that distance at right angles to the former line), it is an easy matter to determine the visual angle under which they are seen. Thus, if for instance we take a series of black and white squares of equal size, we shall be able, under suitable conditions, to determine the acuity of vision (expressed as a definite visual angle) by noting the greatest distance at which they may still be seen as separate squares, and are not blurred into a more or less homogeneous shaded surface, the details of which cannot be distinguished. Experiments have shown that with normal visual acuity the smallest visual angle may be taken at not much less than 1 minute. The calculated size of the retinal image corresponding to this angle (which again varies according to the position of the second nodal point relatively to the retina) agrees sufficiently closely with the distance between the centres of two contiguous perceptive elements of the retina. It is thus probable that a limit is given to the possible acuity of vision by the anatomical structure of the retina, and that the theory is correct which infers that, in order that two objects may be seen separately, the size of the image of the intervening space must at least be so great as to equal the distance between the centres of two contiguous cones, so that it may be possible for one cone at least to receive a different impression from those around it.

The test types above described, and which are those in general use, are based on the assumption that the normal eye is capable of distinguishing objects having an angular separation of 1 minute; thus the black and white portions of the letters in the last line are separated by intervals which subtend angles of 1 minute to the eye at a distance of six mètres (the height of the letters subtending angles of 5'-50), so that when they are seen at six mètres the

visual acuity ($V = \frac{6}{\theta}$ or 1. The same angles are subtended by the other lines at the distances 9, 12, 18, 24, 36 and 60 mètres respectively. It has been found that the assumption of 1 minute as the size of the visual angle corresponding to full visual acuity makes it rather too small than too big; this is more than counterbalanced in practice when alphabetical letters constructed on this basis are employed, owing to the large angle subtended by the letters as a whole, as well as to the elaboration of an imperfect image arrived at by education and practice. Thus we find that the corresponding more regular figures which constitute the illiterate test type of Snellen cannot be deciphered at the same distance as the letters, and that children or individuals who have only just learnt to read, exhibit more difficulty in making out the letters than others who have learnt to make the most of their retinal images. The visual acuity depends on the optical perfection of the eye, the total as well as relative illumination of the objects to be seen, and the degree of functional perfection of the retina and nerve-centres connected with vision.

G. A. BERRY.

VITILIGO. See LEUCODERMA.

VITREOUS, Diseases of the.—The vitreous may be altered by inflammation, by invasion of its substance from without, or by degenerative changes.

Acute hyalitis is not infrequently of a suppurative character. The changes may be very rapid and severe, implicating also the optic disc, retina, and uveal tract. This suppurative panophthalmitis may be secondary to a general pyæmic condition—e.g. after severe wounds of distant parts—or it may arise from purulent uveitis, the result of similar local causes. Its symptoms are congestion of the globe, loss of vision, yellowish-white turbid opacity in the vitreous chamber, dulness of aqueous humour and iris, and chemosis. The globe becomes proptosed and loses its mobility, and a thin purulent discharge escapes from beneath the swollen upper lid. Corneal perforation or, more commonly, shrinking of the globe without perforation is the ultimate result. The active symptoms are associated with marked general febrile disturbance.

But a suppurative hyalitis may run its course with little visible implication of any other structure than the vitreous itself. In such cases the condition may be indicated simply by ciliary congestion, loss of sight, opacity behind the lens, and, ultimately,

retraction of the peripheral part of the iris, with slight softening and gradual shrinking of the globe.

Such inflammations may be the result of wounds implicating the vitreous itself rather than the uveal tract, or consecutive to or concomitant with some forms of meningitis in children. Of this last nature are the greater part of the cases now absurdly designated as *pseudo-glioma*. Their diagnosis from true retinal glioma depends upon the history, the absence of hæmorrhagic spots or blood-vessels from the opaque surface behind the clear lens, the gradual retraction of the iris-periphery, and the development of diminished tension. But suppuration may be localised so as to constitute a true abscess of the vitreous.

Non-suppurative hyalitis may be the result of wounds; of various inflammations of the iris, ciliary body, and choroid, especially those exciting sympathetic disease; or aroused sympathetically. It is also associated with retinitis as a frequent late lesion of secondary syphilis. It is found also in glaucoma and myopia, and is the usual result of the presence of cysticerci, blood-extravasations, and other foreign bodies. The condition is indicated by the presence of local films or haze, or of universally-distributed fine, dust-like opacities. Unless the opaque particles are so far forward and so large as to be visible by oblique illumination, we shall find the ophthalmoscopic mirror, held at perhaps a foot's distance, to be the best means for their individual recognition. A plane mirror has often a distinct advantage over the usual concave one. In many cases, however, the optic disc simply looks reddish, like the sun seen through a mist, and the fundus reflex generally somewhat obscured. The disease may result in the restitution of the normal condition, in the formation of opaque shreds or films, or in the shrinking and condensation of the vitreous. In severe cases, the retina, choroid, and sclerotic will follow the shrinking vitreous till the eye is reduced to a small, deeply-grooved stump. If, however, the ciliary body has been little involved, the globe may preserve its proper size and shape notwithstanding the detachment caused by the general or partial inflammatory adhesion of the retina to the shrinking vitreous. More rarely, the retina is left *in situ* (detachment of the vitreous), separated by serous fluid from the vitreous, which forms either a translucent, filmy, well-defined hemisphere on the posterior surface of the lens and ciliary processes, or a convoluted-shaped detachment from the retention of

its connection with the optic disc. A localised, traumatic, non-suppurative hyalitis may simply encapsule a foreign body, or form a band marking the track of a penetrating wound. Detachments of the vitreous are common after operations attended by loss of vitreous, and are consistent with a fair degree of sight.

It is only in the acute cases of glaucoma that hyalitis can be diagnosed by rapidly-occurring vitreous haze. Pathological examinations of advanced cases always show the vitreous firm and containing an excess of cells, especially those of the spindle and stellate variety. The central canal—the canal of Cloquet—is widely dilated, and the vitreous, as a comparatively thin layer, lines the internal retinal surface. Consequently, retinal detachment is of rare occurrence in this disease.

Vitreous opacities are extremely common in high degrees of myopia, and take the form of freely floating films or veils. They are probably the result of a low inflammatory condition, with subsequent shrinking and condensation of the vitreous. This may be partial or entire, in which case the shrunken vitreous is only represented by a much-folded convoluted-shaped membrane, which, retaining its attachments at the disc, and at and in front of the ora serrata, floats freely on any sudden movement of the eye between the much-increased fluid of the subhyaloid space and that of the canal of Cloquet. From the want of proper support, detachment of the retina and trembling of the iris are easily brought about. Finer vitreous opacities—for the most part invisible by the ophthalmoscope—the result of very slight inflammation, are also much complained of by myopic patients. The opacities of syphilitic hyalitis present at first a fine dust-like appearance. They may entirely disappear, or floating opacities like those described in extreme myopia may be formed. The retina is also involved in this condition, so that the disease is really a retino-hyalitis.

Cysticercus in the vitreous is very rare in this country as compared with Germany. The cyst is of rounded form, with bluish-grey surface and white shining margin. The hyalitis aroused by it may be slight; but irido-choroiditis and shrinking of the globe are the more common result.

Penetrating foreign bodies, such as fragments of metal and gun-cap, if they do not cause speedy suppurative panophthalmitis, usually result in the same manner.

Hæmorrhages into the vitreous may depend upon some constitutional condition,

such as gout, hæmophilia, or anæmia; but they sometimes occur, especially in young adults, without obvious cause. One eye alone is frequently affected, and relapses are not uncommon. Minute hæmorrhages are sometimes found in severe glaucoma, and depend on disease of the vascular walls. The opacity resulting from blood-infiltrations is greater than can be caused by the amount of blood present, and is due to a secondary hyalitis. The result is, usually, the formation of opaque films or of freely floating shreds, as has been described in myopia. Similar appearances are common after retinal detachments from blows, and are probably there also of hæmorrhagic origin.

Tubercle or glioma cells may infiltrate the vitreous, extending loosely from the adjacent affected retina or uveal tract. It is even supposed that tubercle may develop primarily within the vitreous.

Persistent hyaloid artery is rare. It is seen as a greyish cord extending along the canal of Cloquet, from the disc to the back of the lens-capsule.

Musæ volitantes are only subjectively observed by the patient, and trouble him more or less according to the sensitiveness of his retina. They continue their movement after the eye has been brought suddenly to rest, and thus can be diagnosed from the fixed opacities, which may be of serious moment. Against a white surface, they present to him the appearance of fine filaments which are variously twisted and beaded. They are supposed to be due to minute opacities, which normally exist within the substance of the vitreous.

Fluid degeneration of the vitreous (synchysis) occasionally occurs as a senile change. It is indicated ophthalmoscopically by the free mobility of fine suspended particles, and also by tremulousness of the iris (iridodonesis). The floating particles may appear very bright and glistening (sparkling synchysis). They are made of cholesterine crystals, in occasional association with tyrosine and phosphates.

The *pathology* of hyalitis has been much discussed. The increased corpuscular elements, which at its onset give increased firmness to the vitreous, must be derived either from immigration from the neighbouring blood-vessels, or from a multiplication of the rarely-occurring corpuscular elements of the vitreous itself. These are either small (diam. = .009) and rounded, with comparatively large nuclei, or similar in body to these but tailed, or much larger (diam. = .024), well-defined and vesicular,

with lateral nucleus. The first-described is probably the form from which the others are derived, and is most abundant in the peripheral parts of the vitreous. Immigration must be the main factor in metastatic suppuration and in the rapidly-developing cases of suppurative panophthalmitis from local injuries. But slight local abscess of the vitreous, or non-suppurative hyalitis developing round a foreign body, is far more likely to be due to a direct cell-proliferation, since the surrounding vitreous has occasionally been observed to remain clear during the development of such local processes. Moreover, in the earlier stages of suppuration of the entire vitreous, we find the opacity not universally distributed but collected mainly into two areas, one covering the ciliary body and in less degree the optic disc and retina, and the other occupying the vitreous centre. The last is mainly constituted by large granular cells of faint outline and faint feebly-staining nucleus, each very like in many respects to the larger cells of the normal vitreous; whereas the former contains, together with a few of these, many smaller multinucleated corpuscles. The larger cells of the centre are probably, like those of local abscesses, derived from a proliferation of the smaller vitreous corpuscles, whereas the cells of the periphery are derived mainly from the neighbouring blood-vessels, to whose colourless corpuscles, as seen within their lumen, they present a very close resemblance. But the multinucleated corpuscles, whencesoever derived, are certainly in a state of very rapid proliferation. In non-suppurative hyalitis many-tailed cells are ultimately developed, by the contraction of which the condensed filmy vitreous occupies less space. Such cells are most abundant near the ciliary body, where they may often be seen to extend from between the elements of the pars ciliaris retinæ. Or, if similarly connected with the retina, they will by their contraction detach this membrane. Otherwise, the vitreous may leave the retina *in situ*, and form a well-defined translucent hemisphere on the posterior surface of the lens and ciliary body, or a convolvulus-like detachment.

Treatment.—When suppuration appears to be threatened, we shall find local warmth, together with the internal use of quinine and stimulants, to be the best means at our disposal. If foreign bodies are the cause, their removal, either by the magnet or otherwise, should be attempted. Failing the accomplishment of this, we should proceed at once to the enucleation of the globe. The symptoms of fully de-

veloped suppurative panophthalmitis are only relieved by time or by the enucleation of the globe. Cysticercus may, in rare cases, be successfully removed by operation. The hyalitis of myopia demands rest, the use of tinted lenses of proper strength, and local blood-letting. That of syphilis is most effectually treated by mercury. If circumstances will not allow of the sufficiently free and long-continued administration of this drug by the mouth, we shall do well to give daily vapour-baths of calomel (gr. x.). Or perchloride of mercury in aqueous solution (1-60) should be daily injected into the muscles, in doses of from 2 to 6 minims. Vitreous hæmorrhages, supposed to be dependent on gout, will be best treated by the regimen and drugs appropriate to this disease. Those due to anæmia will be favourably influenced by the administration of iron and of arsenic. In any case the bowels should be carefully regulated. Hot foot-baths may be also of use in recent cases. Nitrate of pilocarpine has been vaunted as a means of removing vitreous opacities. It should be given subcutaneously in daily diaphoretic doses (gr. $\frac{1}{8}$). But the writer's experience has not confirmed the statements as to its value. The constant electrical current may daily be used for ten minutes, in strength just sufficient for the patient to appreciate a flash when the current is made or broken. One pole should be placed on the nape of the neck and the other over the closed lids. Some, however, prefer the interrupted current. *Muscæ volitantes* and persistent hyaloid artery admit of no treatment.

W. A. BRAILEY.

VOMITING as a Symptom in Injuries and Surgical Diseases.—In the following injuries vomiting as a symptom is of importance:—

(1) **HEAD-INJURIES.**—Concussion is commonly followed by vomiting, even in slight cases. The symptom comes on at the commencement or during the period of reaction, and is favourable. Care should be taken to turn the patient's head well on one side. In slight cases of concussion, the patient does not usually vomit more than once or twice. More persistent vomiting, without corresponding reaction, points rather to contusion or laceration of the brain. In some cases of head-injury, with but slight cerebral symptoms, the vomiting is oft-repeated; in such cases it is probable that the vomiting centre in the medulla has suffered injury or disturbance. *See HEAD-INJURIES.*

(2) **SPINAL INJURIES.**—Injuries to the cervical, more rarely to the upper dorsal spine, are occasionally followed by persistent vomiting. Mr. Erichsen records a case in which, after a blow on the cervical spine, vomiting persisted daily for many months. Usually, the symptom occurs soon after the injury. In head and spinal injuries the vomiting is attended with little or no retching or distress, and it does not become stercoraceous; the tongue remains clean, and the breath pure. One-grain doses of calomel, frequently repeated, will often relieve the symptom. *See BACK AND SPINE, Injuries of the.*

(3) **ABDOMINAL INJURIES.**—These are all likely to be followed by vomiting, which is indeed a most constant, though not an invariable, symptom. When the rupture is high up the vomit is usually bloody. It is persistent, attended with severe pain, great collapse, and commonly occurs early, while the retching is constant. In a case, however, of ruptured duodenum under the writer's care, in which the patient walked into the hospital and thought he was scarcely injured, the vomiting did not commence for some hours and was very slight. As a rule, however, the nearer the injury is to the stomach the earlier does the vomiting begin. *See ABDOMEN, Injuries of the.*

(4) **SURGICAL DISEASES.**—In all cases of intestinal obstruction, vomiting is a most important symptom. In acute obstruction, arising from volvulus, intussusception, &c., it commences early, persists, is associated with great pain, and rapidly becomes stercoraceous. At first the vomit is green and watery, then contains much mucus; soon it becomes darker in colour, and then acquires the characteristic odour. The time that elapses before the vomit becomes stercoraceous affords no reliable test as to the situation of the obstruction. The vomit, though spoken of as fæulent, is not actually so. The theory of 'inverted peristaltic action of the intestines' is now, the writer believes, abandoned, and the vomiting ascribed to nervous influence. *See INTES-TINAL OBSTRUCTION.*

Acute strangulation or internal hernia not involving the intestine will give rise to vomiting of the same description, for vomiting will occur when any of the abdominal contents are strangulated—e.g. a portion of omentum or of the bladder, &c. Often, in the former case, the omentum seems to constitute the sole contents of a hernia, but includes and is wrapped over a loop of gut, forming an 'omental sac.' So,

too, when an empty hernial sac is inflamed, in acute orchitis of a retained testis, &c.; in fact, when the lesion affects any part supplied by the abdominal sympathetic nerves.

The symptom, if persistent, is the most important indication for operation; if allowed to go on too long, it will not cease after relief of the obstruction by operation. In external strangulated hernia the symptoms, as regards vomiting, are the same as in the preceding cases. In rare cases of strangulated hernia vomiting is a late symptom, but in such there will be a feeling of nausea and a tendency to retch. The more acute the strangulation the earlier will the vomiting commence; but it often happens, particularly in old herniæ, that the patient vomits once almost immediately after the descent of the hernia, especially when, as too often happens, some purgative medicine has been taken. The hernia may still, though irreducible, not be strangulated. Bearing this in mind, it may be laid down as a rule in cases of strangulated hernia, that the occurrence of decided vomiting, if repeated on more than three occasions, demands gentle taxis under anæsthesia, and if this fails, operation. More lives would be saved if the greater gravity of the operation did not too often deter the surgeon from adopting the same rules of treatment in acute internal obstruction. Persistent vomiting after operation for obstruction is the most grave symptom that can occur. See HERNIA, Strangulated.

In the rare form of hernia known as Littré's, or partial enterocoele, the vomiting is less persistent, and not stercoraceous; but in these cases no complete obstruction exists, as is constantly shown by the passage of fæces.

In chronic intestinal diseases vomiting marks the completion of obstruction. It is rare consequently in malignant disease of the intestines.

It not infrequently happens that, after operation for strangulated umbilical hernia, the division of the stricture is almost immediately followed by profuse vomiting attended with scarcely any contraction of the abdominal muscles. It will occur when the stomach or upper part of small intestine is involved. This passive kind of vomiting occurs when the stomach is full of unabsorbed fluid, and is the gravest possible symptom. Vomiting occurs early in all forms of acute peritonitis. The pain is often intense in these cases, but the vomit does not tend to become fæculent. In profound shock, after grave operations, vomiting occurs

often in a severe and constant form. Here nutrient and stimulant enemata are demanded.

C. T. DENT.

VULVA, Affections of the.—The *vulva*, or external genital apparatus in the female, comprises the following parts:—In front is situated the eminence known as the *mons pubis*, whence on either side extend backwards the *labia majora*, which limit the genital fissure behind by their union in a thin fold of mucous membrane, the *fourchette*, at the anterior border of the perineum. From the *clitoris*, seated immediately beneath the *mons*, two diverging folds of mucous membrane enclosing erectile tissue, and known as the *labia minora*, or *nymphæ*, pass backwards to blend with the inner surface of the *labia majora*. The intervening space, termed the *vestibule*, shows the opening of the urethral canal (*meatus urinarius*) seated in the middle line immediately in front of the vaginal orifice.

I. MALFORMATIONS, involving more or less complete obliteration of the genital fissure, are always congenital, and constitute one or other of the various forms of the condition usually known as hermaproditism.

Adhesion of the Nymphæ is a minor malformation occasionally found in young children, either as a congenital condition or as the result of some local inflammatory mischief in early infancy. On separating the *labia majora* in such cases, the vulvar opening is seen to be partly occluded by a membranous structure connecting the margins of the *nymphæ*, and continuous posteriorly with the skin of the perineum. The membrane, however, is always deficient anteriorly, where an aperture exists corresponding with the opening of the *meatus urinarius*; and the introduction of a probe at this point will at once reveal the true nature of the deformity.

Treatment.—The adhesion, as a rule, can be easily torn through by means of a probe, or by forcible separation of the parts; but, if necessary, it can be divided on a director with the knife; the only after-treatment required being the introduction of a strip of oiled lint for a few days, in order to prevent re-union of the torn surfaces.

Hypertrophy of the Clitoris is sometimes seen in infants. Removal by means of the thermo-cautery may be deemed advisable.

Acquired malformations in the adult, as the result of cicatricial contractions after sloughing due to injury, are extremely rare.

II. SURGICAL INJURIES.—*Contused* or *incised wounds* of the labia occur either from intentional violence, as kicks, blows, or stabs; or more commonly as accidental injuries, from falling or sitting upon some pointed or sharp-edged object. The extreme vascularity of the tissues, while always causing free hæmorrhage at the time of the accident, has the advantage of promoting rapid healing.

Treatment.—After careful cleansing, the skin-edges should be accurately adjusted by sutures, and a dry pad of some antiseptic material be applied to the vulva and retained in place by a T-bandage, the patient meantime being confined to bed. Should leucorrhœal discharge exist, daily syringing of the vagina with a carbolised lotion will be required in order to avoid any decomposition.

Contusions—due to violence—may lead to considerable swelling and inflammation of the labia, best treated by the early and continuous application of cold compresses.

Hæmatoma, or *thrombus*, are terms applied to a rapidly formed swelling of the labium, caused by a subcutaneous effusion of blood—an accident which is favoured by a varicose condition of the vessels of the part consequent upon intrapelvic pressure. In addition to external violence as an exciting cause of this injury, may be mentioned the pressure of the child's head during parturition, or even the sudden strain of a violent muscular effort—inducing rupture of an over-distended vein. The rapid formation of the swelling, in a patient subject to varix, will at once suggest the true nature of the injury.

Treatment.—Absolute rest, with the continuous application of an ice-bag, will prevent further effusion and favour absorption. For some few days after the accident, the bladder and rectum should be evacuated without the patient's being allowed to strain in any way. If suppuration occur, poulticing, followed by early incision, will be required. This operation should, as far as possible, be performed with all antiseptic precautions, in order to avoid risk of septic absorption, especially when the accident has occurred during parturition.

Lacerated contusions, with free external hæmorrhage from a ruptured varicose vein, may prove rapidly fatal from loss of blood. The patient should at once assume the recumbent position, when firm pressure by means of a pad and a T-bandage will usually control the bleeding.

Fissures about the nymphæ or fourchette, resulting from injuries inflicted

during coitus or a first labour, sometimes give rise to much discomfort and pain on exertion, and may even render intercourse unbearable. Complete rest for a few days, combined with the use of boracic acid ointment or of some other mild application, will in most cases readily suffice for their cure, when recent. Failing this, division with a sharp knife, followed by the employment of iodoform powder or ointment, may be required.

III. INFLAMMATION OF THE VULVA (*Vulvitis*).—1. *In Children*.—Simple catarrhal inflammation of the mucous surfaces occurs in weakly infants from neglect of cleanliness, or from sympathetic irritation due to the presence of thread-worms. The parts are found swollen and tender, and bathed in muco-pus.

Treatment.—Frequent ablution with warm lead lotion, followed by the application of boracic acid ointment, will usually effect a cure, if any co-existing source of irritation be at the same time removed.

Noma is a rare disease met with in unhealthy, ill-fed children during the course of, or as a sequela to, measles, scarlet fever, or typhoid. The affection, which commences by the formation of a small vesicle seated upon an indurated base, leads rapidly to localised gangrene of the part, accompanied by much inflammatory œdema. Constitutional symptoms are always severe, and may readily induce fatal exhaustion.

Treatment.—The constant use of warm charcoal poultices, or of strips of lint soaked in hot boracic lotion and covered with oiled silk, answers best as local treatment. Meanwhile, good nourishment and wine must be freely administered, and the patient's strength maintained by means of a mixture containing ammonia and bark, or chlorate of potash and quinine.

2. *In Adults*.—Simple vulvitis, due to deficient cleanliness, irritating vaginal discharges, skin-affections, or other sources of irritation, is not of very uncommon occurrence, and if neglected may readily become chronic. In the *acute* form, the parts are swollen and tender, the mucous surfaces red and irritable, and coated with mucopurulent discharge. The *chronic* form is always accompanied by much irritation (*pruritus*); the labia are thickened and indurated, and often the seat of painful fissures.

Treatment during the *acute* stage requires rest in bed, combined with avoidance of all friction between the opposed surfaces, which should be frequently bathed with warm lead lotion and kept covered with

strips of wet lint protected by means of oiled silk. Should abscess of the labium occur, it must be opened by an early incision. When the affection has become *chronic*, any discoverable cause of irritation must be removed, and the parts then kept scrupulously clean and frequently dusted over with oxide of zinc and starch powder.

Specific vulvitis, due to gonorrhœa, does not differ materially from the ordinary acute affection, excepting that it is usually accompanied by some urethritis, and often leads to formation of abscess. The vaginal mucous membrane also is very often acutely inflamed at the same time. For treatment, see VAGINA, Acute Inflammation of the.

IV. SKIN-AFFECTIONS. — 1. *Eruptions* affecting the vulva—whatever be their nature or origin—invariably give rise to intense irritation (*pruritus*), relief from which is usually sought in rubbing or scratching. This, in time, leads to abrasions and inflammatory changes, which readily mask the original characters of the eruption, and, in long-standing cases, may induce marked alterations in the appearance of the parts due to thickening and induration of the tissues.

2. *Parasites*.—The presence of the *pediculus pubis* causes a lichenoid eruption chiefly affecting the mons and adjacent parts of the labia majora. The large size and colour of the parasite render its detection an easy matter. Thorough inunction of a mercurial ointment, or frequent ablution with 1–20 carbolic lotion, followed by the application of a vaseline ointment containing one part in ten of carbolic acid, will usually destroy the source of irritation and cure the disease.

The only other parasitic affection here met with is *scabies*, which may cause an impetiginous eruption involving the mons and the neighbouring parts of the abdomen and thighs. The characteristic itching and the existence of the rash elsewhere—about the patient's wrists and fingers—will suggest the nature of the disease, which yields readily to the use of sulphur ointment.

VENEREAL WARTS (*Verruca*), are met with on the vulva quite independently of any constitutional taint, but simply as the result of persistent irritation of the mucocutaneous surfaces from neglect of cleanliness. They are thus not uncommonly found coexistent with gonorrhœal discharges. Their most usual seat is on the inner aspect of the labia, where they appear as irregular

cauliflower-like growths, often more or less pendulous, and occasionally of considerable size.

Treatment.—When small, they are readily removable with scissors, after which their base should be touched with nitrate of silver. Scrupulous attention to cleanliness, and the use of a dusting powder of oxide of zinc, or calomel and starch, will usually prevent recurrence. If large, the growths should be removed with the help of the thermo-cautery, in order to avoid hæmorrhage.

CHANCRES occurring upon the female genitals may be either simple (non-infecting) or specific (syphilitic). Their most usual situation is just within the fourchette, or upon the nymphæ; but they may occasionally be seen upon the cervix uteri; and very rarely upon the vaginal mucous membrane. When seated externally, they are sometimes difficult of detection, owing to the inflammatory œdema caused by the irritation due to their presence.

The *simple non-infecting* chancre is the form most commonly met with, occurring usually as multiple sores of a circular shape with sharply-cut but shallow edges, and often accompanied by much swelling and tenderness of the parts.

Treatment.—A crystalline powder of iodoform, dusted upon the sores twice daily, will rapidly modify their character and promote their healing. All friction between the opposed surfaces of the labia must, meantime, be avoided by the interposition of strips of lint spread with boracic acid or some other antiseptic ointment, and whenever possible the patient should be confined to bed. If thought desirable to at once destroy the special virus of the sores, this may be effected by the application of fuming nitric acid, while the patient is anæsthetised; on the separation of the resulting slough, a healthy surface is left, which will heal readily if perfect cleanliness be ensured with avoidance of friction.

The *specific* or *syphilitic* chancre occurring on the mucous surfaces of the female genitals rarely presents the characteristic induration of the true Hunterian sore, owing to the constant moisture of the part. When seated upon the mons or the outer aspect of the labia, it will, however, possess the ordinary features of a hard chancre. In any given case, the presence of a single sore, apart from its special character, which may be masked by its situation and by the degree of irritation to which it has been exposed, will point to the probability of a specific origin.

Treatment.—Beyond strict attention to cleanliness, and the subdual of inflammation by appropriate means, the local treatment consists in the use of black wash, or of calomel and starch powder as a dry application. For the constitutional management of the patient, see SYPHILIS.

MUCOUS TUBERCLES are met with as a local secondary manifestation of constitutional syphilis, which fact in relation to their origin constitutes an important distinction between them and the ordinary venereal warts. They consist of flat, broad-based, slightly elevated patches of soft papillary growth, usually seated upon the inner surface of the labia, where they readily spread by contact. The discharge due to their presence is extremely contagious.

Treatment.—Frequent ablutions, followed by the use of a calomel and starch dusting powder will answer best in the way of local treatment, which must be supplemented by constitutional remedies.

V. TUMOURS.—*Hypertrophy.*—A simple variety of this deformity is occasionally seen affecting the labia minora, which may become so thickened and pendulous as to cause serious inconvenience, and thus require removal. Another form of enlargement, often traceable to syphilis, and resembling in a minor degree the condition known as elephantiasis in tropical countries, is sometimes met with involving the labia majora, and thence extending forwards over the mons and backwards over the skin of the perineum. The clitoris is also occasionally the seat of this disease. The growth, which consists in a thickening of the layers of the true skin, combined with increased formation of connective tissue and dilatation of the lymphatic spaces and ducts, presents on the surface a hard, irregular, tuberculated appearance. When of long standing, it may constitute a mass of considerable size, causing much discomfort by its weight and bulk. Excision with the cautery knife is the proper treatment for all such growths.

Fibromata, identical in structure with the same formations as met with in the uterine walls, sometimes develop in the labia majora. Their tendency is to become pedunculate, when their removal is a matter of no difficulty.

Lipomata, originating in the adipose tissue of the mons or of the labia, are of rare occurrence. When large they may require to be excised.

Cysts, due to distension of the vulvo-vaginal glands, as the result of inflammatory occlusion of the mouth of the duct, are

not infrequently seen. They give rise to an oval-shaped or somewhat lobulated swelling at the lower part of the labium, tense and elastic to the touch, and not tender unless inflamed. The retained secretion consists of a clear glairy fluid, occasionally of a brownish hue.

The only *symptom* usually complained of is discomfort felt in walking; but, should the cyst inflame and suppurate, it will give rise to all the signs of an acute abscess.

Treatment consists in complete evacuation of the cyst, and subsequent destruction of its secreting surface. This may be effected, after free incision practised on the inner aspect of the labium, by seizing the base of the cyst with a tenaculum and everting as much as possible of its wall, which is then excised with scissors. Another plan consists in freely destroying the lining membrane by means of the thermo-cautery. In either case, the cavity should be afterwards plugged with carbolised lint or iodoform gauze, and allowed to close by granulation.

Pudendal hernia, corresponding with scrotal hernia in the male, may result from a congenital patency of the process of peritoneum, which to a greater or less extent invests the round ligament in its passage from the external abdominal ring to be inserted into the dartoid tissue of the labium. The possibility of such a condition, although a very rare one, should always be borne in mind when examining any tumour of the labium. The presence of the prolapsed gut, apart from the occurrence of any strangulation, which is extremely uncommon in this situation, usually gives rise to a sense of discomfort sufficient to draw attention to the part. Impulse on coughing, with resonance on percussion, combined with the possibility of reduction by taxis and position, will serve to reveal the true nature of the swelling. The hernia should be supported by means of a well-fitting truss; or, if desirable, a radical cure may be attempted.

Hydrocele of the canal of Nuck is an extremely rare condition, due to a sacculated collection of fluid in the unobliterated portion of the process of peritoneum above alluded to. The irreducibility of the swelling and the absence of resonance and impulse would serve to distinguish it from intestinal prolapse; while puncture with the needle of a hypodermic syringe would settle the diagnosis. Aspiration of the fluid followed by injection of tincture of iodine as in the case of an ordinary hydrocele, constitutes the most effectual treatment.

VI. NEW GROWTHS.—*Malignant disease* of the vulva, usually of an epitheliomatous type, is not very uncommon, although much less frequently seen than cancer of the cervix uteri. The affection, which may originate in any part of the cutaneous or mucous surfaces, usually commences in the immediate neighbourhood of the clitoris as a small nodular growth, which in time ulcerates and gives rise to a sore with raised and indurated margins, showing no tendency to heal. Progress at first is slow and painless, but, as the ulceration extends, severe attacks of hæmorrhage occur, and rapidly reduce the patient's strength. As a rule the inguinal glands soon become involved.

Treatment.—Complete extirpation of the diseased tissues at an early stage of the affection, before the occurrence of secondary deposits, offers the only chance of relief.

This may be effected by means of the knife or scissors, followed by the application of the thermo-cautery for the arrest of hæmorrhage.

Vascular growth of the meatus urinaris—*urethral caruncle*—is a somewhat common affection in middle-aged women, often productive of great discomfort. It may be described as a species of angioma developed from the mucous membrane at the entrance of the urethral canal, where it appears as a vascular excrescence of a bright red colour, bleeding readily when touched, and usually extremely sensitive, often to such a degree as to give rise to exquisite agony on micturition or during coitus. The only effectual treatment consists in destroying the growth with the thermo-cautery, while the patient is under the influence of an anæsthetic.

W. A. MEREDITH.

W

WARDROP'S OPERATION FOR ANEURISM. *See* ANEURISM.

WARTS (*Synon.* Verrucæ).—Warts are small growths mainly consisting of hypertrophied papillæ of the skin.

Several distinct growths besides the true wart (*Verruca vulgaris*) are included under the general term 'warts.' Tyloma is sometimes regarded as a warty growth, but it differs altogether from warts in structure, being simply a hypertrophic growth of epidermic structures without hypertrophy of the papillary layer of the skin.

Warts are of two kinds—*Acquired warts* and *Congenital warts*.

Acquired warts are met with in two varieties—(1) *Verruca vulgaris*; (2) *Verruca senilis*.

Verruca Vulgaris.—Common warts first appear under the cuticle as smooth, slightly raised, little tumours; as, however, they increase in size and prominence, the smooth epidermic covering is lost, and then the top of the wart presents a rough granular or filiform surface, which is due to the exposure of the enlarged papillæ. Warts may appear on any part of the body, but they are most common on the hands in children, and on the scalp in adults. Sometimes they appear in great numbers, so as to constitute a veritable eruption. The writer has met with several instances in which

the face of a patient has been completely covered with small, discrete, warty growths.

Verruca senilis differs from the common wart in being softer and more flat. Warts of this kind usually occur in great numbers, especially on the backs of old people. They are of a greasy character, and generally of a darker colour than the surrounding skin. They are essentially a senile change.

Verruca acrochordon, *see* ACROCHORDON.

Congenital warts are not very common. They do not generally take the rounded shape of common warts, but form groups which are irregular both in size and distribution. They are really a kind of malformation of a limited portion of the skin, in which there is a permanent hypertrophy of the papillæ. Congenital warty growths generally assume a dark appearance, and, when they form considerable and elongated patches, they constitute the *Ichthyosis hystris* of writers; it is, however, an error to regard these warty patches as any form of ichthyosis, which is essentially a *symmetrical* disease, involving changes in the skin of a different kind altogether. Congenital warty growths are always *unsymmetrical* in distribution, are wart-like in structure, and are surrounded by perfectly healthy skin; in these respects they contrast remarkably with ichthyosis. The term *Ichthyosis hystris* has been mis-

applied, and should now be dropped out of our nomenclature. See *ICHTHYOSIS*.

Treatment.—Soft warts are easily cured by painting them daily with a saturated solution of salicylic acid in flexible colloid. The best caustic for hard warts is a saturated solution of potassa fusa in water.

R. LIVEING.

WASHING OUT THE BLADDER.

See *PROSTATIC HYPERTROPHY*.

WATSON'S PLASTER OF PARIS SWING SPLINT for excision of the knee consists of two parts:—(1) A wooden back splint cut away freely opposite the knee, so that the leg and thigh pieces are only connected by a narrow bridge behind the ham; (2) a suspension rod, made of telegraph wire or hoop iron, reaching from the toes to the groin, and across the knee in the form of a bracket. The limb is enveloped in cotton-wool and placed on the back splint, to which it is fixed by plaster of Paris bandages. The suspension rod is next placed in position along the front of the limb, and fixed by the final layers of the bandage. The splint is suspended to a cross-bar placed over the bed.

WEBBED FINGERS.—The digits may be united by coalescence of the bones (see *FINGERS*, Congenital Deformities of the), but a more common deformity is that known as web-fingers, in which the digits are united throughout the whole or part of their length by a prolongation of skin, similar in nature to that which normally intervenes between their bases. Sometimes the union is more intimate and formed by a closer union of the deeper tissues, when no separation is possible; but, with the more usual web, a certain amount of lateral movement and therefore of usefulness is attainable. The deformity is less often symmetrical than not.

Treatment.—Where a true web exists, it is desirable to effect an artificial separation, especially of the thumb from the index, and of the little finger from its neighbour, and of the other fingers in order of their relative importance. Many devices have been adopted for this purpose. The main principle should be to avoid cicatrization as far as possible; and this is best effected by making a dorsal and a palmar flap, the one to be applied to the outer edge of one finger, and the latter to the inner edge of its fellow. When the union involves the deeper structures, more harm than good will come of interference, though success has in a measure been obtained by

engrafting skin from the haunch and other parts.

As opposed to the condition above described, the clefts between the fingers are sometimes found to extend for an unnatural distance into the palm, and even up to the carpus. As a general rule such conditions interfere but slightly with the usefulness of the member, and surgical interference is more likely to do harm than good.

JOHN H. MORGAN.

WHITEHEAD'S OPERATION. See *TONGUE*, Operations for Removal of the.

WHITLOW, or **PARONYCHIA**, is a generic name for an acute inflammatory affection of a finger, which is often extremely painful, and may lead to very serious consequences. The varieties of the disease are easily classified according to the tissue in which the inflammation commences, and the symptoms and consequences of these varieties are different in degree and in importance.

1. Acute inflammation of the skin (*paronychia ungualis*). This is by far the least serious form, and is seen most frequently in children as the result of some unhealthy condition of the blood.

Symptoms.—The pulp of the ungual phalanx becomes swollen, and is slightly painful; it is at first red, and afterwards hot and throbbing. On the third or fourth day a bulla appears containing serum, which becomes mixed with pus, and often with blood. There is not much constitutional disturbance, but as the condition of one finger improves, others, on the same or on the opposite hand, become similarly affected. The bulla breaks, and, its contents becoming discharged, the surface beneath is raw and tender, but soon is covered with healthy epidermis.

Treatment.—The state of the tongue and of the bowels should be corrected by a slight mercurial purgative, and some tonic in the form of bark, quinine, or iron given internally. The fingers must be frequently bathed with warm water, and some boracic ointment on lint is to be applied, covered with cotton-wool to promote warmth and to prevent injury.

2. A more painful variety of whitlow is that in which the inflammation attacks the areolar tissue of the last phalanx. This usually results from the introduction of septic matter through some slight scratch or crack in the skin, although this cannot always be detected. The end of the finger becomes tense both on the palmar and

dorsal surfaces, and is extremely painful, with throbbing in the part. The inflammation may spread up the finger and into the hand, or there may be lymphangitis with swelling of the lymphatic glands. As a rule, however, the inflammation is confined to the structures of the last phalanx, all of which may become implicated. From the fact that the long flexor tendon has in this situation no prolongation of its sheath, the tendon at its insertion frequently becomes involved, especially if proper treatment is delayed, and the tendon eventually will come away as a slough, and necrosis of the phalanx will often follow. The amount of pus is small in proportion to the pain or to the constitutional disturbance.

Treatment should consist of making at an early period a deep clean incision along the centre of the palmar surface of the phalanx. This should never be carried to the end of the finger, where the large supply of nerve-ends makes the part exquisitely tender. It is well not to wait for suppuration to occur, and indeed it may often be prevented by early incision. Warm antiseptic lotions should be applied, and the finger should be frequently held in very hot water, and the hand must be raised or carried over the opposite shoulder. If destruction of the tendon or of the bone has taken place, they must be allowed to separate of their own accord.

3. The third form of whitlow has a different seat of origin—viz. the sheath of the flexor tendon. Paronychia tendinosa or thecal abscess commences in the sheath, either spontaneously, or as a result of some slight puncture through which septic matter is introduced.

Symptoms.—At first there is a throbbing, painful swelling on the palmar surface of the middle or proximal phalanx, which gradually extends so that the whole finger is involved, and the tension and swelling gradually spread upwards into the palm, which becomes red, doughy, and distended with pus, and this condition may even extend beneath the annular ligament of the wrist into the forearm. The pain, from the distension of the canal, and the constitutional symptoms soon become severe. If not treated by early incision, the pus is discharged from one or more sinuses at the side of the finger, which are marked by fungous granulations, and through which also the sloughing portions of tendon are discharged; later, the bones and joints become implicated, and in the former sequestra are formed, which remain to be exfoliated. As the matter finds vent the

swelling diminishes, but when the tendon has been destroyed the finger becomes contracted, withered, and useless.

4. In the remaining form of whitlow, paronychia osseosa, the inflammation commences in the bone or periosteum, generally of the terminal phalanx; but these parts are more usually involved as a consequence of one of the other varieties of this disease, and in any case the symptoms resemble those of the second variety, except when disease of the bone follows upon crushes or other such injuries, and death of the whole or part of the bone ensues.

Treatment.—In all the three latter forms early incision through the affected part, in the middle line and down to the bone, is the only means of allaying pain and of preventing extension of the disease. After this, the hand should be held in very hot water every two hours, and in the interval should be raised and enveloped in lint steeped in warm boracic lotion. Due time must be allowed for the separation of necrosed parts of tendon or of bone, and, as soon as the inflammation has subsided, frequent passive movements of the joints must be employed. If the destruction has been extensive, amputation of the finger may become necessary. In the constitutional treatment, a free purge should be given early, and bark and ammonia, with stimulants and opium to relieve pain. If matter has collected in the palm, it must be afforded a free and early exit.

JOHN H. MORGAN.

WOOL-SORTERS' DISEASE. *See* MALIGNANT PUSTULE.

WOUNDS, Treatment of.—Recent solutions of continuity in the external soft structures of the body constitute the great majority of wounds; but the term has a much wider application, etiologically, physiologically, and therapeutically. A subcutaneous rupture of the tendo Achillis and a transverse fracture of the tibia, an opening into the knee-joint, and a simple fracture through the femoral condyles, are lesions of unequal seriousness; but they are nevertheless wounds, essentially alike biologically and surgically, repaired by the same process, and amenable to analogous principles of treatment. The parallel is substantially true, however various be the causes producing the solution of continuity; although some wounds—e.g. from gunshot or from the bite of rabid animals—present special therapeutic indications. *See* GUNSHOT WOUNDS; HYDROPHOBIA.

It is to the treatment of wounds strictly so called, and as met with in ordinary surgical practice, that this article is specially devoted.

The typical and most common wound is an incised one, and it may be taken as the basis of the description of wound-treatment generally. The peculiarities of punctured wounds do not materially affect the principles and plan of dressing; but contused and lacerated ones deserve some special notice.

In the case of a slight, clean-cut wound, all that is usually required is to stanch the bleeding by pressure with a dry absorbent material, and keep the edges in close contact. Pressure for a few minutes may suffice to cause adhesion, which at first is a purely mechanical sticking together, rapidly converted into a living bond of union by the process of organisation. A little goldbeater's skin, or brushing the part with collodion, common glue or gum, protects from the air and maintains coaptation. If the wound be a little more extensive, an absorbent pad and bandage, or non-irritating adhesive plaster, may be usefully employed to secure immobility. Additional protection may be given by a splint, which is best prepared of pliant material, so as to admit of being moulded to the part and left to solidify. Such splintage may be made with folds of gummed paper, wire or thin wood, light rough millboard soaked in dextrine or paraffin, absorbent tissue impregnated with paraffin, or plaster of Paris.

In larger lesions, the precept to be observed in the first treatment of all wounds becomes specially important—to search for and remove foreign bodies. As a general rule, too much inquisitiveness is to be discouraged; but if a wound be of considerable depth, it is only by probing it that the presence of foreign bodies can be ascertained. When admissible, the finger is the best searcher; but a porcelain-tipped probe and a magnet have their special uses in detecting metallic bodies. Whatever be the means of exploration, it is scarcely possible to exercise too much gentleness.

ARREST OF HÆMORRHAGE.—One of the first indications in the treatment of wounds is to stop bleeding from divided vessels. In the articles **HÆMORRHAGE**, **LIGATURES**, and **TORSION**, the methods for arresting bleeding in surgical practice generally are fully dealt with; and it will only be necessary here to recapitulate briefly, with special reference to wound-treatment. Too much anxiety about bleeding from small vessels before the edges of a wound are

brought together is, as a rule, inadvisable; very frequently it is mischievous. More than a century ago, Mr. Robert Mynors of Birmingham gave this wise counsel:—‘We need not be too solicitous about the security of small arteries by ligature; for, if the recently divided soft parts are gently brought together, and nicely retained in contact, if a passive state of the muscles surrounding them is duly attended to, and their own natural contraction properly assisted by the judicious and artful application of a bandage, a perfect security from future hæmorrhage will be insured, as well as the most likely means employed to obtain a speedy and easy cure of the wound by the first intention.’ If the oozing be rather more free than can be controlled by mere apposition of divided surfaces, light pressure with a pad or sponge squeezed out in iced water or in very hot water will be found a good hæmostatic. As aids to immobility and pressure in the arrest of hæmorrhage, styptics are valuable, and foremost amongst them may be named the compound tincture of benzoin, collodion, and styptic colloid. If these simple means be not sufficient to check bleeding, acupressure or forcipressure, ligature or torsion must be resorted to, with a tourniquet or Esmarch bandage, according to the circumstances of particular cases; but the beneficial influence of position should never be neglected as a powerful agency in reducing the rate and amount of blood-flow. By raising the hand and bending the elbow at an acute angle, the radial pulse is at once reduced to bare perceptibility. So with the thigh and leg, and the popliteal and tibial arteries; the physical effect being almost as obvious, and for the same reasons, as when an india-rubber pipe connected with a water-tap is raised and bent. Whatever be the chief agency relied upon for arresting bleeding from wounds—be it a ligature, forcipressure, or a styptic—immobility, position, and pressure are powerful contributors; and they are also the most potent factors in maintaining wound-apposition, preventing irritation, and promoting repair.

WOUND-CLEANSING.—Dirt is foreign material, which it is necessary to remove with care before attempting the apposition of wound-edges. If that can be done without liquid, all the better; but if any fluid be required for cleansing purposes, it is advisable to use equal parts of spirit and water, or a saturated solution of borax with the addition of about one-eighth of its bulk of glycerine. Another good cleansing liquid may be prepared with equal parts of water,

glycerine, and methylated spirit. Mr. Bryant recommends for the same purpose water, to which sufficient tincture of iodine has been added to make it a light sherry colour; and Dr. B. W. Richardson has suggested, with the same object, proof spirit containing tannin and glycerine. In using any of these liquids it is advisable to avoid ordinary sponges—a very common source of contagious poisoning. Camel-hair pencils, pledgets of lint, soft hempen tow, or absorbent gauze and cotton tissue are very good cleansing agents. A still better one is prepared on the writer's suggestion by Messrs. Bourroughs & Wellcome. It is an artificial sponge made up with a combination of elastic and absorbent fibres in an absorbent gauze covering, and enclosing any antiseptic prescribed in a central capsule. This can be preserved any length of time, and the antiseptic set free, by squeezing the capsule to breakage, just before the sponge is required for use. On the same principle, very efficient absorbent and antiseptic pads may be constructed for wound-dressing.

ANÆSTHETICS.—If the patient bear the exploration and cleansing of the wound without much pain (and it is understood that all manipulation is to be most gentle), then the next step in the dressing may be proceeded with. If much pain be unavoidable, an anæsthetic should be administered, for upon the accuracy of every step in the first dressing the healing of a wound largely depends. Nothing is more important than to save pain, which is a cause as well as a sign of physiological disturbance, and a very potent factor in the initiation and development of pathological changes.

WOUND - APPPOSITION.—The wound cleansed and the bleeding stanchd, its edges have to be adjusted and means provided for keeping them in accurate apposition. This is the time to make provision for drainage. It is important in closing the wound to include within it as little fluid as possible, and for this purpose it is well to exercise equable pressure and to give exit at the dependent angle to fluid as it is exuded. Only experience can teach whether the wound may be completely closed with safety; but, as a rule, direct union may be attempted throughout their whole extent, in wounds of the head and face and upper limbs, for in those parts compression can be effectually exercised, and immobility secured. But when the serous cavities are penetrated, or the large vessels tied, and when the bone is implicated, as in amputation, compound fracture, and excision, the safest course is not

to close the fresh wound completely, but to make adequate provision for drainage.

DRAINAGE, as a general rule, should be provided for at the dependent aperture, either by an india-rubber tube, or, by a finer drain, such as horsehair, silk, or catgut. These agents may be left of sufficient length externally to perforate the dressings, so that these need not be changed while the liquid is drained outward into a convenient receptacle—a physical process which may be powerfully assisted by position and pressure. One of the chief advantages of absorbent dressings is that, provided the edges of the wound be not hermetically closed through its whole extent, exuded fluid may be taken up without the intervention of a draining conduit.

SUTURES.—Metal is the preferable material for sutures; and iron, while very much cheaper, is as good as silver; but catgut, hemp, or silk may also be used. The number of sutures and the depth to which they are inserted must depend upon circumstances. It is of no use bringing together edges and leaving deeper wounded parts asunder; and the combination of deep and superficial sutures is very desirable. Accurate apposition being of the first necessity, as many sutures must be inserted as are necessary to secure it. When adhesive plaster is used, the writer prefers Southall's elemini; but in fresh wounds preference is to be given—as an aid to, or substitute for, sutures—to strips of absorbent gauze or tissue soaked in styptic colloid, tincture of benzoin, or collodion. When the latter agent is employed, allowance must be made for its contraction, which is least in the flexible preparation. While accurate apposition is important, tension must be avoided, because always opposed to wound-healing. See **SUTURES**.

PRESSURE AND IMMOBILITY.—Pressure is a most beneficial agency in maintaining temporary, and promoting permanent, union of wound-edges. It not only keeps the parts mechanically together and so prevents nerve-tension, but it opposes stasis and effusion, and promotes absorption. Pressure is best exerted by soft absorbent bandages, equably applied without reverses over absorbent tissue or pads, which should be used abundantly, and with all necessary means, such as moulded splints and suspension, for maintaining the nearest possible approach to absolute immobility.

When the dressing is complete, much remains to be done for the patient's comfort to ensure perfect rest. That position of the body is the best which is the easiest,

and limbs require to be fixed or suspended, and the bed to be made or raised, so as to facilitate venous return and favour muscular relaxation. The quieter the part and the patient are kept, the better, in conformity with the truth embodied in John Hunter's generalisation:—'*The first and great requisite for the restoration of injured parts is rest.*'

INFREQUENT DRESSING.—When the first dressing is to be disturbed can only be determined by closely watching constitutional symptoms; taking heed of the patient's feelings, pulse, respiration, and temperature. Infrequency of dressing is most conducive to successful wound-healing. When the first dressing is removed, it is preferable to cut the bandages than to unroll them. If styptic dressings have been employed, they must be softened with ether or common spirit, and the utmost care taken to effect the least possible mechanical disturbance and to cause the minimum of nervous apprehension. Every step of the dressing should be conducted with the utmost lightness and without hurry. What sutures are to be removed, whether drainage-tubes are to be withdrawn or shortened, must be determined by the condition of parts. Applying the same kind of materials as used in the first dressing with equable elastic pressure, attending to physiological position, and securing the nearest possible approach to perfect immobility and painlessness, the treatment of the wound may safely be conducted to complete cicatrisation.

ANTISEPTICS have, so far, only been mentioned incidentally; but the materials recommended for the wound-dressings, such as borax and glycerine, tincture of benzoin, styptic colloid, and collodion, are in an eminent degree antiseptic. So, too, is the action of drainage and of all absorbent dressings, in direct proportion to their power in taking up secretions and leaving the neighbourhood of a wound clean and dry, in a condition as little as possible favourable to putrescence. In so far as rest, position, and pressure prevent irritation, they are opposed to vascular excitement and attendant effusion, which is the material for decomposition. Thus they are in effect antiseptic. The question in wound-treatment is not one of antiseptics or no antiseptics, but of the form and proportion in which they should be employed in particular conditions. The great antiseptic is life. The living tissues have a natural preservative power, which, if guarded and conserved by the surgeon on physiological principles, offers the surest guarantee for

healthy repair, which is only an adaptation and extension of normal nutrition. In exceptional cases—e.g. in the wound formed in the opening of a psoas abscess—when perfect drainage and pressure are impracticable, the need for antiseptic applications is exceptionally great. It is under such circumstances that the merit of the Listerian method (*see* ANTISEPTIC SURGERY) is best illustrated; but even in many of those *cliniques* in which the carbolic spray found most favour, it has been abandoned; while such recognised principles of wound-dressing as cleanliness, drainage, and immobility, infrequent dressing, position, and pressure, are steadily making way.

Cleanliness, and infrequent dressing which is the corollary of the great principle of absolute rest or immobility, are powerfully aided by the use of *absorbent and dry dressings*.

The healing of wounds, once apposition has been effected, is favoured by dryness, not in the mere literal sense of the term, but as opposed to accumulation of fluid. In general, it may be said that repair and healing, liquefaction and decay of animal structures, proceed together. Healing is rapid in direct ratio to dryness and compactness of tissue; in inverse ratio to effusion and laxity. This is the key to the physico-chemical influence of drainage in favouring wound-healing. The same explanation applies to absorbent dressings, which, by carrying off effused fluids as rapidly as they are poured out, keep the wound clean and dry, and are in direct measure antiseptic. By checking arterial supply, favouring venous return, and preventing extravasation, position and pressure contribute to wound-dryness, and so to wound-healing. By its great affinity for water, glycerine enhances the drying power of absorbent dressings, and its peculiar antiseptic property acts in the same direction. Absorbent, astringent, and antiseptic powders, such as bismuth and iodoform, charcoal, earth, sawdust, and sugar, have a multiple therapeutic action, in which their drying power is one of the principal factors. It is a fact of common knowledge to butchers and housekeepers, that to preserve meat it is essential it should be kept cool and dry,—the freer the current of air around it the better. Any moisture which exudes on the surface from time to time must be wiped off, and the practice of sprinkling with flour or other absorbent material is based on the well-known necessity of keeping the meat dry.

Moistening and putrefaction, drying and preservation, go together. Experience proves that it is along damp courses and alluvial plains that contagia spread, not on sandy hills. So with wounds: the dry ones heal, the wet ones rot in direct proportion as the moisture accumulates. Scabbing typically illustrates what has just been said of drying and healing, as does the influence of poultices in promoting effusion and suppuration, and *pari passu* preventing cicatrisation. It has long been a matter of common knowledge that heat and moisture promote putrefaction; and, since bacteriology has been closely studied, it has been proved that, as a general proposition, moisture is essential to the development of bacteria, thus explaining the antiseptic action of dry and absorbent dressings. While, as a rule, dry wound-dressings are to be preferred, it may sometimes be desirable to moisten them, or to protect the edges with boracic, elemi, zinc, or other ointment, to prevent too great adhesiveness. In the widely varying conditions of wounds, local and constitutional, healthy and diseased, principles must in practice be subordinated to special indications, and therapeutic resources be judiciously combined; but, as a rule, the drier wounds are kept the more quickly do they heal, and proportionately less is the amount of suppuration.

A great variety of materials has been employed in the preparation of absorbent wound-dressings, which may be treated with any antiseptic, but the absorbent gauze and cotton tissue manufactured by Robinson & Son, Chesterfield, is, probably, one of the very best materials for surgical dressings—very cheap, absolutely pure, and powerfully absorbent; it is also very elastic, has a perfectly level surface, is of uniform thickness, and may be folded and cut to any shape. It requires to be used freely to make efficient padding for equable compression. Soaked with collodion, paraffin, or plaster of Paris, the tissue makes an efficient splintage, and by enclosing within a fold or roll of the tissue picked oakum or tenax, pads may be prepared of great use in cases attended with profuse discharge.

The cotton-wool treatment long since advocated by Mayor and Burggraave, and more recently by Guérin, is carried out with greater facility and thoroughness when absorbent cotton or tissue is employed. The very process by which the cotton is rendered absorbent is one of depuration antagonistic to wound-putres-

cence, and the deprivation of fatty matter renders cotton more elastic and a better medium for the application of equable pressure. This is specially exemplified in the treatment of

CONTUSED AND LACERATED WOUNDS.—Bruising or contusion may complicate an incised wound, and sometimes, especially over bone, a blow may produce a wound with such well-defined edges that it may be extremely difficult to say whether it have been produced by a cutting instrument or by a blow. In such a case the wound may be treated as an incised wound, special care being taken to provide for the drainage of any existing or succeeding subcutaneous extravasation. There is also greater need for uniform elastic pressure, because the swelling which immediately attends a contused wound is essentially hæmorrhagic, and is best constrained by equable compression with absorbent elastic materials. More commonly contused wounds are also lacerated, and care has to be taken in effecting apposition not to introduce sutures and draw upon soft parts, the vitality of which is so much compromised that very slight violence may suffice to extinguish it. Some parts of a contused wound may well bear sutures; in others the apposition may be well secured by strips of plaster, and, better still, by absorbent gauze or lint, soaked in collodion, styptic colloid, or compound tincture of benzoin. Provision being made for drainage, and a compressing absorbent pad adjusted with accurately applied bandage, attention being paid to physiological position and immobility, the wound may be left with impunity for some days; and it is remarkable to note how extensively torn and bruised wounds so treated often heal by the first intention. Local pain, rise of temperature, and other signs of constitutional disturbance, are obvious indications for inspecting the injured part; but if the first dressing be perfectly accurate, and physiological position and absolute rest enjoined, the healing of contused and lacerated wounds is often rapid and uncomplicated. It may be a question whether much bruised parts should be cut away before apposition is effected. It may be prudent to do so when the crushing has obviously proceeded to the extinction of local life; but if there be any doubt, chance of recovery should be allowed. The styptic applications recommended have a decided antiseptic action, and the absorbent pads take up the products of disintegration. Under the circumstances just referred to, borax, bismuth, or iodoform powders have a

beneficial drying and anti-putrescent action.

In amplification of the preceding general sketch of wound-treatment, reference may be made, in addition to the articles already quoted, to the following: ADHESION; COLD; COLLODION; DRAINAGE; IMMOBILITY; IRRIGATION; POSITION; PRESSURE; REST; SUSPENSION. It now remains to offer some observations on prognosis, constitutional influences, and comparative physiology and therapeutics, in connection with wound-treatment.

Prognosis of Wounds.—A wound being visible presents no diagnostic difficulty so far as the mere question of its existence is concerned; but in determining the parts involved, the presence of foreign bodies, and other complications, ample scope for diagnostic accuracy presents itself as an important preliminary to prognosis and treatment.

In prognosticating the effects of wounds, it is essential to bear in mind that all solutions in the continuity of living tissues are important until completely healed; since some of the most trivial wounds every now and then prove fatal, and complications, such as blood-poisoning and tetanus, sometimes appear when cicatrization is far advanced. Wounds are not necessarily dangerous in proportion to their extent; thus, a scalp half-torn from the cranium may heal by the first intention after re-adjustment, while a very small wound on the vault may imminently endanger life, in consequence of penetration through the bone, constituting that most formidable lesion, a punctured fracture of the skull. For obvious anatomical reasons, exceptional danger attaches to, and special treatment is required in, wounds into the large visceral cavities, into the joints, and in the course of the great blood-vessels and nerves. Those are matters fully dealt with under separate headings throughout this work.

Constitutional Influences and Treatment.—Irrespective of position and extent, the constitutional state has a direct bearing on the issue of all wounds. Patients suffering from albuminuria and diabetes do badly after comparatively trivial injuries; and it is always prudent to take the constitutional state into careful consideration, in prognosticating the course of wounds after operation or accident. The thermometer, and the pulse and respiration ratio, yield the most reliable diagnostic and prognostic data. So long as those are satisfactory, the constitutional powers unimpaired, and the main sources of

blood and nerve supply uninjured, very formidable-looking wounds heal, as a rule, under good management. No precise rules can be laid down for saying what wounds may heal; and the question of amputation is often debated on the assumption that a particular lesion is so extensive as to preclude the possibility of local repair. But experience justifies very great faith in recuperative powers. Conceding that some lives have been lost for want of timely amputation, there is good reason for believing that not a few limbs are sacrificed which might be saved by carefully putting into practice the physiological principles of wound-treatment. A clear perception of correct principles is obviously important; but accurate and painstaking, gentle and thorough manipulation in dressing is not less essential.

The surgeon has to take constitutional influences into consideration in determining the propriety of wound-making in a variety of operations. The well-known disposition to hæmorrhage in some constitutions—bleeders popularly so called—weighs against the performance of all but vitally important operations, and imposes the necessity of extreme care whenever a solution of continuity occurs by accident or design. Phthisis, scrofula, and syphilis powerfully affect the progress of wounds, and demand appropriate treatment in the several conditions. There can be no doubt that temperate persons, other things being equal, exhibit superior powers of healing, to say nothing of the delirium tremens so apt to follow injuries after habitual intemperance. Nervousness is a disturbing cause in wound-convalescence, and renders exceptionally important the precautions which should always be observed to avoid giving pain and alarming patients. The value of anæsthetics in fulfilling those objects is too well known to need more than reference; but what is scarcely sufficiently appreciated is the possibility of avoiding almost all pain in wound-dressing, by extreme lightness and nicety of manipulation.

In watching the constitutional state of a wounded patient much may be learned from the expression, manner, and position. The pulse and respiration ratio is an indicator of first importance; and so is the temperature of the skin to the touch, still more so to the thermometer. A rise of the latter by two or three degrees is always important, but not necessarily alarming. Such rise not infrequently occurs after irregular action of the bowels, a detail apt to be overlooked. A mild aperient or

an enema frequently brings down the temperature to normal in a very few hours. Amongst the agencies powerfully influencing the constitution, diet, tranquillity, and ventilation must not be overlooked. As a rule, patients after injuries require liberal diet, but excess may be as great an evil as deficiency. If sufficient food be taken, the need for stimulants is proportionately less; but the symptoms and needs of particular patients must be watched and met, independently of any theoretical preoccupation. Tranquillity, mental and bodily rest, cannot be too complete, while ventilation without cold draughts is obviously important. Close, small rooms have caused the death of many persons suffering from wounds, whose local and constitutional condition might speedily have been changed by removal into a larger apartment or to the outer air under the cover of a tent.

In illustration of the science and practice of wound-treatment in the human subject, valuable information may be derived from the

Comparative Physiology of Wound-healing and Therapeutics.—That the process of repair after wounds and injuries generally is only an adaptation and extension of the physiological process of nutrition, is a truth borne out alike by original research and clinical observation in the study of man and animals. The direct bearing of comparative anatomy and physiology on the study of those sciences in immediate relation to man is admitted by common consent; but comparative pathology is less frequently appealed to, though at least as fruitful in lessons bearing directly on the practice of human surgery. That is especially so in the matter of wounds. Suppuration after injuries is comparatively rare in brutes, healing of their wounds usually rapid and uncomplicated. Whereas even small wounds in man are attended with serious and sometimes fatal results, recovery is almost the invariable rule, even after large wounds, in animals. The difference has a great bearing on the etiology of suppuration and on the question of wound-treatment, and is due to a variety of causes, constitutional and physical. Beasts are always temperate, and in comparison with many men virtuous. Their procreation is largely governed by interested intelligence, and they are consequently comparatively free from the blighting and rotting operation of hereditary disease. The horizontal position of animals is favourable to drainage; when at rest they are not smothered under cloth-

ing which prevents bodily ventilation and confines heat, which is a potent factor in putrefaction; and the open air which animals usually inhabit is favourable to wound-drying and scabbing. This very exposure to the air is an exceptional cause of one form of traumatic death of animals after injuries—that is, tetanus. It is important to bear in mind the traditional use in veterinary practice of such antiputrescents as preparations of tar and turpentine, sulphate of copper and corrosive sublimate, and the tinctures of aloes, benzoin, and myrrh. But the fact that healing of the wounds of animals can be safely relied upon in the open air is not consistent with the doctrine which, assuming the maleficent potency of ubiquitous atmospheric germs, gives elaborate directions for their destruction.

The treatment of wounds by exposure to the air, which is favourable to drying and scabbing, and the treatment by irrigation, which opposes putrefaction in proportion as it favours drainage and reduces local heat, however different at first sight are alike antiseptic methods, acting on such well-established antiputrescent agencies as drainage and drying. The same remark applies to the combination of rest, position, and pressure, with absorbent and infrequent dressing. In a wounded limb accurately adjusted, compressed, dried, immobilised, and suspended, muscular, nervous, and vascular activity are reduced to the minimum consistent with bare life and physiological repair; while pathological change is prevented by removal of existing and possible causes of irritation, and by interception of putrescible material. Scientific explanation apart, experience proves that the tendency of wounds to heal is naturally very strong; and that great success may be obtained in assisting that natural disposition by a wide variety of plans, provided they be carried out with technical accuracy and thoroughness, conformably to sound physical and physiological principles.

SAMPSON GAMGEE.

WRIST-JOINT, Amputation at the.—

This is an operation now seldom performed, having obtained, in the writer's opinion, a somewhat ill-deserved disrepute. It may be done by—(1) the circular, (2) the elliptical, (3) the antero-posterior, (4) the single lateral-flap methods. These are generally known as the operations respectively of Velpeau, Guérin, Lisfranc, and Dubrueil.

The position of the joint can be determined, according to Malgaigne, by either

strongly bending back the hand, when at the summit of the angle formed by it and the forearm the articulation will be found; or again, by drawing a line between the styloid processes, two and half lines above this imaginary line corresponding to the joint. In performing this operation, great care should be taken, during the disarticulation, not to open the radio-ulnar joint, as a wound of it may ultimately lead to impairment in, or loss of, the movements of pronation and supination of the forearm. When the radio-carpal joint is opened, therefore, the point of the instrument should be directed towards the carpus, and not in the direction of the articular surfaces of the radius and ulna. By doing this, the chances of wounding the radio-ulnar joint and triangular fibro-cartilage are minimised.

In performing the *circular operation*, an assistant should retract the skin, and an incision on a level with the bases of the metacarpal bones should then be made. In this incision the skin only should be involved. It should be dissected back as far as the radio-carpal-joint—the position of which has previously been determined with accuracy—the tendons should then be divided, and the joint opened either from before backwards, or from side to side. The radial, ulnar, and occasionally the interosseous arteries are, as a rule, the only vessels requiring ligation. Drainage is in this operation most desirable, as, in the event of suppuration, there is a danger arising from purulent collections forming within the tendinous sheaths. It has been advised to divide these to 'the extent of one or two inches' to prevent these purulent collections. This procedure is, however, in the writer's opinion, quite unnecessary.

Flap amputations at the wrist-joint cannot conveniently be made by transfixion, owing to the convexity of the carpus posteriorly and to the bony prominences and concavity in front. The flaps, therefore, had better be made by division of the parts from without inwards.

The *elliptical method* of Guérin consists in dissecting a full-sized flap from the palmar aspect of the joint. In order to get a more accurate adaptation of the edges of the wound, a dorsal incision, with its convexity looking upwards, should be made; and, on the disarticulation being made, the single palmar flap is then brought over the articular surfaces of the radius and ulna. Care should be taken to commence the incisions well below the styloid processes, as otherwise there is a danger of protrusion of these processes through the wound.

The *antero-posterior flap method* of Lisfranc consists in making an anterior or palmar flap by transfixion, a narrow, double-edged knife being used for the purpose, and a dorsal flap equal in length is then made by dissection. The hand is kept in the position of pronation during the formation of both these flaps. The joint is then opened at the styloid process of the radius, and disarticulation thus effected.

Another method of amputation at the wrist is one of which the writer has had experience, and entertains a favourable opinion. Mention is made of the procedure by Bell, and it is described by M. Dubrueil as follows:—'Commencing just below the level of the articulation, while the hand is pronated, the surgeon makes a convex incision, beginning at the junction of the outer and middle thirds of the arm behind, reaching at its summit the middle of the dorsal surface of the first metacarpal, and terminating in front, just below the palmar surface of the joint, at the junction of the outer and middle thirds of the breadth of the arm. The flap being raised, the wrist is disarticulated, beginning at the radial side. A circular incision finishes the cutting of the skin.'

The cases in which amputation at the wrist is mainly indicated are extensive compound comminuted fractures of the carpus and metacarpus, resulting usually from gunshot injuries, crushing from machine accidents, caries of the carpus and metacarpus too extensive to justify resection, burns, and gangrene. WILLIAM STOKES.

WRIST-JOINT, Diseases of the.—Acute inflammation of the wrist-joint is usually traumatic, rheumatic, or pyæmic. The intercarpal joints are frequently involved in the same process which attacks the radio-carpal joint; so also are the sheaths of the adjacent tendons.

Chronic disease of these joints is most often of scrofulous origin, but is also not uncommonly the result of the degeneration of inflammatory products in old or ill-nourished persons, after the subsidence of a more acute traumatic inflammation. It is also met with in the form of osteo-arthritis.

Acute inflammation of the wrist and carpal joints gives rise to pain, heat, and swelling. The pain is often severe, and greatly aggravated by the least movement. The swelling is most obvious over the back of the joint.

For *treatment*, rest must be ensured to the joint by applying a splint to the palmar surface of the forearm and hand, which

should reach only to the junction of the palm with the fingers. The most comfortable form of splint is one with a broad surface for the palm and a separate hollow for the thumb. The forearm should then be slung, or placed on a pillow with the hand well raised. Leeches, cold, or soothing lotions can then be applied, and, after the subsidence of the acuter symptoms, blisters, or pressure by strapping or bandaging over a layer of cotton-wool.

If suppuration occurs, the joint must be opened and drained.

CHRONIC SYNOVITIS usually affects both wrist and carpal joints, and leads to pulpy thickening of the synovial membrane, and often to similar changes in the synovial sheaths of the adjacent tendons. When progressive, much inflammatory thickening of the tissues outside and around the joint occurs; indolent suppuration ensues, and the bone-surfaces become carious, or perhaps some of the carpal bones completely necrosed.

The early stages of the disease should be treated by long-continued rest (best ensured by well-moulded leather splints) and careful attention to the general health. The occasional use of the actual cautery, lightly applied, is often most beneficial.

When suppuration has occurred, the abscess must be opened or sinuses slit up, and the diseased tissue scraped away. Sometimes, one or two of the carpal bones may be found necrosed and their removal be followed by repair; but the result of these cases is often unsatisfactory, especially in persons after middle life. At the best, there is generally much stiffness both of the wrist and of the tendons, which a long course of passive movements only partially overcomes. In young persons, especially if scrofulous, long perseverance in treatment, both local and constitutional, is desirable before proceeding to operative interference. When, however, the joint seems hopelessly disorganised, excision may be performed. But, in the elderly, the surgeon will usually be reluctantly driven to amputate.

J. WARRINGTON HAWARD.

WRIST, Dislocations of the.—Under this heading will be described the dislocations of the wrist-joint proper and those of the lower radio-ulnar joint.

WRIST-JOINT OR RADIO-CARPAL DISLOCATIONS are very rare, and must not be confounded with fractures of the lower end of the radius, which somewhat resemble them. There are three forms—viz. *backwards*, *forwards*, and by *rotation backwards*, given in the order of their relative frequency.

Dislocation backwards of the carpus was believed to be a common accident until Colles and Dupuytren, at the beginning of this century, pointed out that the injury which usually gave rise to the deformity attributed to dislocation was a fracture of the lower end of the radius, now known as Colles's fracture. The signs of dislocation backwards are a projection on the back of the wrist, stretching from side to side, convex superiorly, and about eight lines in height. Anteriorly, there is a projection ending abruptly below, on the margins of which may be felt the styloid processes of the radius and ulna. The first row of phalanges is semiflexed on the metacarpus, and the terminal nearly straight. The forearm, measured from the tip of the olecranon to the head of the middle metacarpal bone, will be found shortened.

Dislocation forwards of the carpus gives rise to a sharp prominence behind (caused by the radius and ulna), which ends abruptly below, and is there concave. In front, the carpus forms a rounded projection. The posterior aspect of the hand appears shortened, and measurement from the olecranon to the head of the third metacarpal bone is abnormally short.

Dislocation by rotation backwards resembles what the writer has termed dislocation by rotation backwards at the metacarpo-phalangeal joint of the thumb, and he believes it has never yet been described. The case on which he founds his description was that of a plumber, aged thirty-one, who came into Guy's Hospital one evening in May, 1884, without hat or coat. He stated he had been fighting with another man, and, being surprised by the police, had run away to escape being taken into custody. In running, he slipped and fell on his left hand, which remained immovably fixed in a state of over-extension. The hand was found forced back, so that the metacarpus formed as nearly as possible a right angle with the dorsal surface of the forearm. The first phalanges were flexed at a right angle with the metacarpus, and the middle and terminal phalanges slightly flexed. The carpus pressed forward the tendons in front of the wrist, but beyond this there was no deformity. The carpus had become over-extended on the radius and ulna without rupture of the lateral ligaments, and the dorsal surfaces of the first row lay in contact with the articular surface of the radius and the inter-articular cartilage. The man was semi-intoxicated, and absolutely refused to take an anæsthetic or morphia. Extension by the aid of assistants,

over-extension and, then flexion, flexion by the aid of assistants and by bending across the knee, were all tried without success. The joint was absolutely locked. He was left for the night, in the hope that when his head was clearer in the morning he would submit to an anæsthetic, but on this being again pressed upon him, he left the hospital unrelieved.

The *treatment* of dislocation forwards or backwards is to extend the hand by grasping the palm, and, as the lateral ligaments have been ruptured, little difficulty has been found in reducing the bones. An anterior splint, reaching from the bend of the elbow to the middle of the palm, should afterwards be worn for three weeks.

RADIO-ULNAR DISLOCATIONS AT THE WRIST are those in which the hand, together with the radius and triangular fibrocartilage, become displaced from the ulna. They are described by some authors as luxations of the lower extremity of the ulna, owing to the prominence assumed by this bone when the hand is displaced from it.

As a complication of fracture of the radius, displacement at the lower radio-ulnar joint, either partial or complete, is frequent. In the majority of Colles's fractures, the lower end of the ulna is unduly movable and prominent, owing to partial dislocation of this joint, and the cases in which the ulna protrudes through the skin are almost invariably associated with fracture of the radius. There are, however, some uncomplicated cases on record. The hand and radius may be displaced either *forwards* or *backwards* from the ulna, without fracture, but when displaced *outwards* it appears always to have been associated with fracture of the radius.

Dislocation forwards is usually caused by forced pronation. It has been produced in children by lifting them by the hands when pronated. The hand is found in a state of semi-pronation and adduction, whilst the lower end of the ulna makes a very distinct prominence on the back of the wrist, escaping externally to the extensor carpi ulnaris, and riding on the back of the radius, so that the wrist is narrowed. In front there is a depression, which the flexor carpi ulnaris is seen to cross.

To reduce the dislocation, pressure should be made on the projecting ulna at the same time that the hand is supinated. Should there be a tendency to relaxation, an anterior splint should be applied, and a pad to keep down the ulna.

Dislocation backwards is rather less frequent than dislocation forwards. It has been caused by forcing the hand strongly into a state of supination. The hand and radius are thrown backwards, and the lower end of the ulna forms a projection in front near the middle of the wrist. On the back of the wrist the deformity is characteristic, for in the position of the lower end of the ulna there exists a well-marked depression. The hand is supinated, and the patient lacks the power of pronating it.

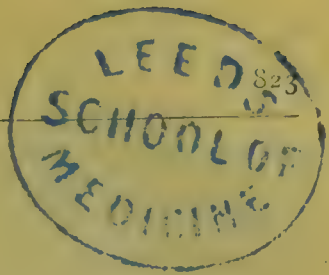
To reduce it, the hand should be abducted and pronated, at the same time that pressure is made on the lower end of the ulna.

COMPLICATED RADIO-ULNAR DISLOCATIONS.—It has been before remarked that, with a fracture of the radius, there may be a great displacement at the radio-ulnar joint, the lower end of the ulna sometimes passing through the skin. In 1882, a dissipated old woman, running to escape from a vehicle, fell on both palms, and was brought to Guy's Hospital with a simple Colles's fracture of one wrist and a compound fracture of the other radius, complicated with protrusion of the lower end of the ulna through the skin, just externally to the flexor carpi ulnaris. There was no difficulty in reduction, and she was at first treated as an out-patient, but phlegmonous erysipelas followed, and she was admitted under the writer's care. Much sloughing took place, necessitating amputation, and she died from exhaustion and degenerate organs. Somewhat similar cases in which the ulna projected through the skin, in one case at the back of the carpus, and in another on the inner side, are described by Cooper. Godlee brought before the Clinical Society, in 1883, a case of compound fracture of the radius, complicated with projection of the lower end of the ulna in front of the flexor carpi ulnaris tendon, which he found impossible to reduce until he had cut down upon, and had sawn off, the articulating surface of the bone. Commenting on his case, he remarked that little deformity or impairment in usefulness resulted from excision of the lower end of the ulna—an observation previously made by the writer of this article before the same society in 1877, when exhibiting a case in which the bone had been excised for tumour.

R. CLEMENT LUCAS.

WRIST-JOINT, Excision of the. *See* JOINTS, Excision of.

WRYNECK. *See* TORTICOLLIS.



X

XANTHOMA (*Synon.* Xanthelasma).
Definition.—A rare affection involving the integument, and subsequently the areolo-fibrous structure, due to the presence of a peculiar yellow-coloured growth, or deposit composed of cells and connective tissue.

Etiology.—Additional information is much needed concerning the conditions of the body which predispose to and determine this rare affection. They are, however, to be associated with defective vital power involving the nutrition and growth of certain tissues. It has been considered probable that some functional disorders of the liver, if not actual structural disease, may stand in causal relationship to xanthoma, not only because jaundice has frequently been associated with it, but also for the reason that organic disease of the liver has frequently been demonstrated *post mortem* to have co-existed with it.

In a report upon twenty-eight cases of xanthoma multiplex in adults, published in 1882, jaundice was present in twenty-three instances, while diabetes mellitus existed in one only of the remaining five. In eight cases of the same disease occurring congenitally, or commencing under puberty, jaundice was reported to be entirely absent. One case is on record in which many organs of the body were simultaneously diseased.

It is obvious, therefore, that as yet no one morbid condition has been found the constant accompaniment of the malady—indeed, in some persons no disorder of the general health has been noticed. Instances have been recorded of xanthoma present at birth or developing in early infancy. Heredity has been proved to be an occasional factor in the disease.

Among the conclusions derivable from the study of the above-mentioned cases of xanthoma multiplex, it may be noted that, etiologically, the cases occurring before puberty differ from those in adult life in having no traceable connection with jaundice or hepatic disease, they are probably to an extent hereditary and may be congenital, moreover they do not affect the eyelids, but involve other regions, of the trunk and extremities. It may also be observed that, in four-fifths of the cases of xanthoma multiplex commencing after

puberty, chronic jaundice from obstruction of bile-ducts existed, while in several of the remainder there had been no disorder of health. Lastly, in these the eyelids were almost constantly involved, and were generally the starting-point of the disease.

Spontaneous disappearance has been noted. The sexes would seem to be about equally affected. A case has recently been reported exhibiting the plane, tubercular, and tuberoso varieties of the disease with perfect symmetry, except for a corymbose band on the right side of the trunk in the trajectory of some cutaneous nerves, and possibly determined by a zona. The patient was a man forty-four years of age, and had an enlarged liver with jaundice of twelve years' standing, which had greatly darkened the skin and was attended with pruritus. The xanthoma had developed in four years, and commenced in the gluteal region. A trace of sugar, but no albumen, was found in the urine.

Anatomical Characters.—Xanthoma is a benign growth or deposit in the cutaneous, mucous, and serous structures, and occasionally, as aforesaid, in the subjacent areolo-fibrous tissue. On microscopical examination, it is evident that the opaque yellow colour is produced by masses of a substance composed of cells of irregular form and size, round, oval, triangular, or rod-shaped, which later may undergo degeneration, and give rise to a crystalline appearance in their midst, or to a fatty metamorphosis with cholesterine plates. These cells are contained in an areolar network of connective tissue.

Description.—Xanthoma presents itself: (1) as isolated tubercles or nodules—X. tuberosum; (2) as smooth laminae or plates—X. planum.

In the tuberoso variety the tubercles are of a yellow colour, isolated or grouped, smooth, and conveying a soft or somewhat elastic sensation to the touch. The planar variety occurs in the form of defined yellow patches or plaques. Upon the palm, a linear arrangement may be present, corresponding to the natural markings or creases.

When it occurs in both its forms, the term X. multiplex is applied. Xanthoma upon the eyelids (X. palpebrarum) is known

by the presence of more or less elevated, rounded, or oblong spots of yellow colour, solitary or multiple. It has a remarkable predilection for the inner angle of the upper eyelid, where it generally commences, is often symmetrical, and later attacks the inner angle of the lower lid.

Occasionally, in severe cases, the whole palpebral aperture may be surrounded by a series of these patches more or less closely arranged. The presence of granules occasionally upon the surface with punctated apertures, corresponding to enclosed follicles, has given rise to the term *X. granulolum* as descriptive of this variety. Unirritated, they are painless.

Inflammatory symptoms are absent, and the surrounding skin has a brownish or pigmented appearance. While the disease was originally observed upon the eyelids, recorded instances have proved its existence on the palms, soles, knuckles, ears, elbows, face, back, abdomen and penis, &c. The mucous membrane of the lips, palate, tongue, also the trachea, bile-ducts, sub-peritoneal tissue of abdomen, and some abdominal organs, have been implicated.

Diagnosis.—The position and arrangement, colour, structure and general characters as described will suffice to determine the affection, no other cutaneous disease having any approximate resemblance to it. The course it pursues is essentially chronic.

Prognosis.—The growth is comparatively unimportant except for its appearance. Internal remedies have no effect upon it. Spontaneous disappearance has occurred.

Treatment.—The general health and requirements of the patient should be attended to, and disordered functions regulated, &c. However, local measures, and of these the use of caustics and removal with the knife, alone can effectually dispose of the disease, should it be deemed expedient to interfere. Much caution should be exercised about the eyelids if surgical means be adopted, on account of possible after-contraction.

J. HERBERT STOWERS.

XERODERMA, or ATROPHODERMA PIGMENTOSUM.—*Definition.* A disease of congenital origin characterised by a pigmented atrophy of the skin, and the development of papillomatous tumours which may become cancerous.

Etiology.—Nearly all the cases recorded, less than forty in number, have commenced in the second year of life; both sexes are

equally liable, but generally when several members of the same family are attacked, as often happens, it selects either the girls or the boys, but not both. Although there is evidently some congenital predisposition, the disease does not develop for some time after birth. It cannot be ascribed to heredity or defects in hygiene, but exposure to the sun has been thought to be an exciting influence. Its real cause, however, is unknown.

Symptoms.—The children are born healthy, and no defect is noticed until the second year, when freckle-like pigmentation of all shades of light and dark brown occurs, sometimes preceded by erythematous papules, and limited to the exposed parts of the body.

Telangiectases develop between the freckles, and subsequently undergo obliteration and leave the skin white and atrophic, like a thin scar. The pigment-spots enlarge and get a deeper tint, and warts develop on them like those of the aged, and from these papillomatous tumours arise, which fungate, and may form masses as large as an orange; or less raised ulcerated patches occur, covered with blood-crusts. These tumours and ulcers may become epitheliomatous, and lead to the death of the patient. The eyes are often affected with conjunctivitis and pannus, and the constant discharge causes some of the ulcers, owing to the pus becoming inoculable. The general health is quite good unless the discharge becomes profuse or cancer develops. Death has occurred about puberty in many instances, but others have reached adult life.

Diagnosis.—If all the symptoms be taken into account, and the history of their development is known, no difficulty can occur, as it is only in some features that it can resemble lupus or atrophic scleroderma, while the rest are very different.

Treatment.—Nothing can be done in the way of cure, but the progress can be delayed by careful attention to the eyes, protecting them and bathing them frequently with boracic acid lotion. The ulcers should be scraped with a sharp spoon if fungating, and healed by the usual means for ulcers, and the tumours removed; fresh ulcers can usually be healed by removing the crust, and dressing them with an ointment of ammoniated mercury, gr. x. to the ounce of lard, or sometimes boracic acid ointment, gr. x. to the ounce, is preferable. No internal medication has any direct effect, but tonics and cod-liver oil may be required.

H. RADCLIFFE CROCKER.

XEROSIS or XEROPHTHALMOS.

Causes and Pathology.—Granular ophthalmia; diphtheritic ophthalmia; improper use of caustic applications. Conjunctival xerosis may also occur as a primary disease, especially in young children, and then leads to total destruction of the eye by ulceration of the cornea, &c., while the patients die of general malnutrition. In a case of this kind the presence of micro-organisms has been demonstrated in the conjunctiva, and similar bodies were found in the pelvis of the kidneys. A remarkable, and as yet unexplained, association of night-blindness with conjunctival xerosis is sometimes seen sporadically or epidemically, the latter chiefly in foreign barracks and prisons. In this form of the affection, similar bacilli have been found in the conjunctiva.

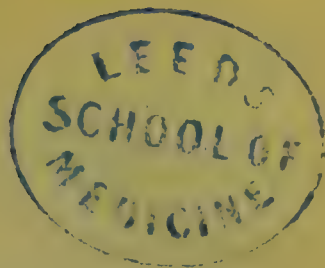
Symptoms and Diagnosis.—This is a

dry, lustreless condition of the conjunctiva. Whitish-grey epithelial scales come away from the mucous membrane, which is contracted in extent. This contraction may be ascertained by drawing down the lower lid, when the inferior fornix will be found to have almost disappeared, and the degenerated conjunctiva to stretch across from the margin of the lower lid to the margin of the cornea. The cornea takes part in the process, its epithelium losing its lustre, with consequent defect of vision.

Treatment.—There is no cure for this condition. Palliation of the distressing symptoms alone can be attempted. Collyria of milk and glycerine, to which may be added some bicarbonate of soda, are the most useful applications, and the eyes should be carefully protected from all irritating influences. H. R. SWANZY.

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Antero-posterior Spinal Curvature; Lateral Spinal Curvature; Flat-foot; Pigeon-breast; Massage; Medical Gymnastics.

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Laryngitis; Neuroses of the Larynx; Syphilis of the Larynx; Tuberculosis of the Larynx; Growths in the Larynx; Laryngoscopy; Aphonia; Dyspnœa; Rhinoscopy; Injuries and Diseases of the Thyroid Gland.

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Xanthoma.

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Abdominal Tumours; Diseases of the Broad Ligaments; Cæsarean Section; Diseases of the Fallopian Tubes; Laparo-Elytrotomy; Oöphorectomy; Ovarian Tumours; Ovariectomy; Porro's Operation; Diseases of the Spleen; Symphysiotomy; Uterine Tumours; Extirpation of the Uterus and Uterine Appendages.

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Caries of the Teeth; Dentition; Extraction of Teeth; Gumboil; Teeth as a Test of Age; Toothache.

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Air in Veins; Artificial Anus; Intestinal Obstruction; Laparotomy for Intestinal Obstruction; Colectomy; Colotomy; Fæcal Abscess and Fæcal Fistula; Enterectomy; Enterotomy; Inflamed Hernia; Obstructed or Incarcerated Hernia; Strangulated Hernia; Articles on Femoral, Inguinal, and other Varieties of Hernia; Lymphadenitis; Lymphadenoma; Lymphangeiectasis; Lymphangitis; Lymphorrhœa; Injuries and Diseases of the Thoracic Duct.

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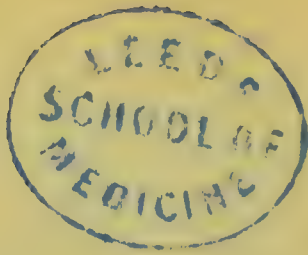
Diseases of the Pharynx; Injuries of the Pharynx; Tumours of the Pharynx; Extirpation of the Pharynx; Pharyngeal Stenosis; Naso-pharyngeal Growths; Retro-nasal Catarrh; Affections of the Septum Narium; Rouge's Operation; Ulceration and Ulcers.

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Tumours; Cystic Tumours; Erectile Tumours; Fibrous Tumours; Adenoma; Enchondroma, and other Special Articles on Varieties of Non-malignant Tumour.

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Ectopia Vesicæ and Epispadias; Hypospadias; Radical Cure of Hernia.



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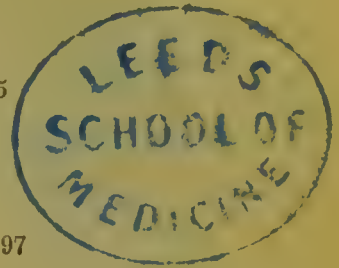
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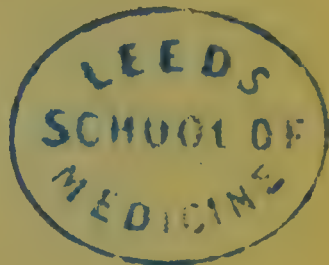
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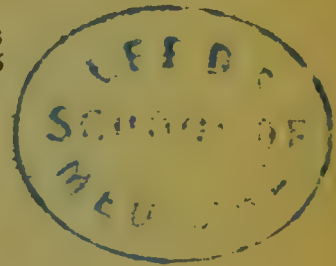
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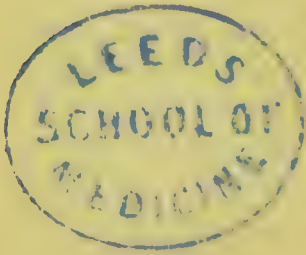
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